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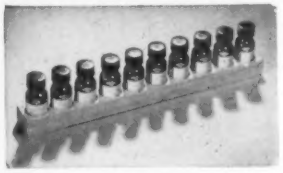

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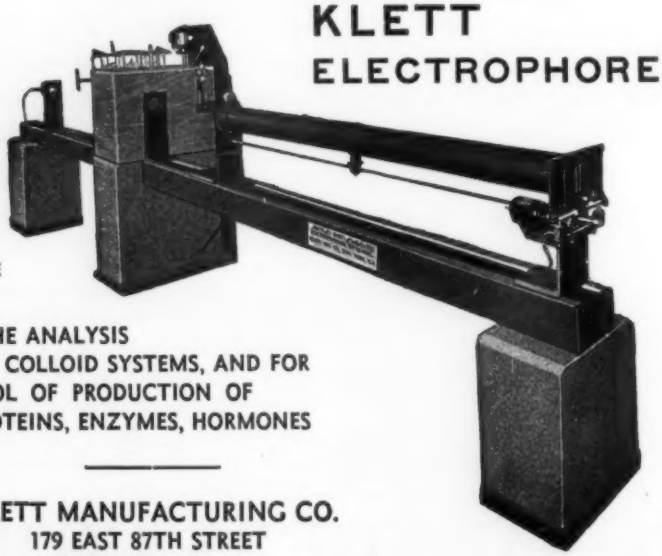

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Distribution of Talent

Recent studies of the Soviet educational system indicate that great emphasis is placed on science and engineering. Students are carefully selected for progression to the next higher level; science and mathematics make up a sizable portion of elementary- and secondary-school curricula; a relatively large fraction of the educational effort at the collegiate level is directed toward the production of scientists and engineers.

In contrast, schools in the United States give mathematics and science less emphasis at elementary and secondary levels and are more permissive in allowing students to choose the fields in which they will specialize and to remain in or drop out of school as they wish.

The net result is that the annual number of graduates in science and engineering has become greater and is increasing more rapidly in the Soviet Union than in the United States. The implications for scientific, technologic, and military progress in the two countries have been much discussed.

Most persons acquainted with the situation agree that the fraction of the nation's talent devoted to scientific pursuits should be increased. There is not such great agreement on proper methods of achieving the desired increase. Few are the extremists who would abrogate the traditional freedom of individual choice, and few are the opposite extremists who would do nothing. Probably the range of choice of greatest concern is the extent to which the persuasive power of the Federal Government and the large foundations should be differentially used to increase the number of science students.

When industrial production and military strength depend as greatly as they do on science and engineering, it would be easy indeed to be stampeded into adopting measures designed to strengthen science at the expense of other areas of human endeavor. So far the temptation has been resisted; several important policy decisions have reflected a continuing belief in the desirability of maintaining maximum freedom of individual choice at collegiate and higher levels. The student deferment policy of the Selective Service System uses quality, rather than field of interest, as the determining factor in deciding which students are qualified to remain in college or university. The Merit Scholarship Program begun this year under Ford Foundation auspices puts no restrictions on the fields in which scholarship winners can study. The staff of the National Science Foundation has spent many an hour in thoughtful discussion of whether it would be socially desirable to exercise the foundation's authority to offer undergraduate scholarships in the sciences when similar offers are not available in other fields, and so far has not taken that step.

Underlying all of these courses of action is the assumption that it is better to educate all young men and women of high ability than it is to pick out those who are interested in a particular area. The record is far from perfect in achieving this ideal, for many persons of high ability do not continue their education to the level that would enable them—and society—to make the most of their talents. In the long run it seems likely that science will profit at least as much from increasing the over-all number of students of high ability as it would from a more narrowly conceived effort, and that society as a whole will profit more.—D.W.

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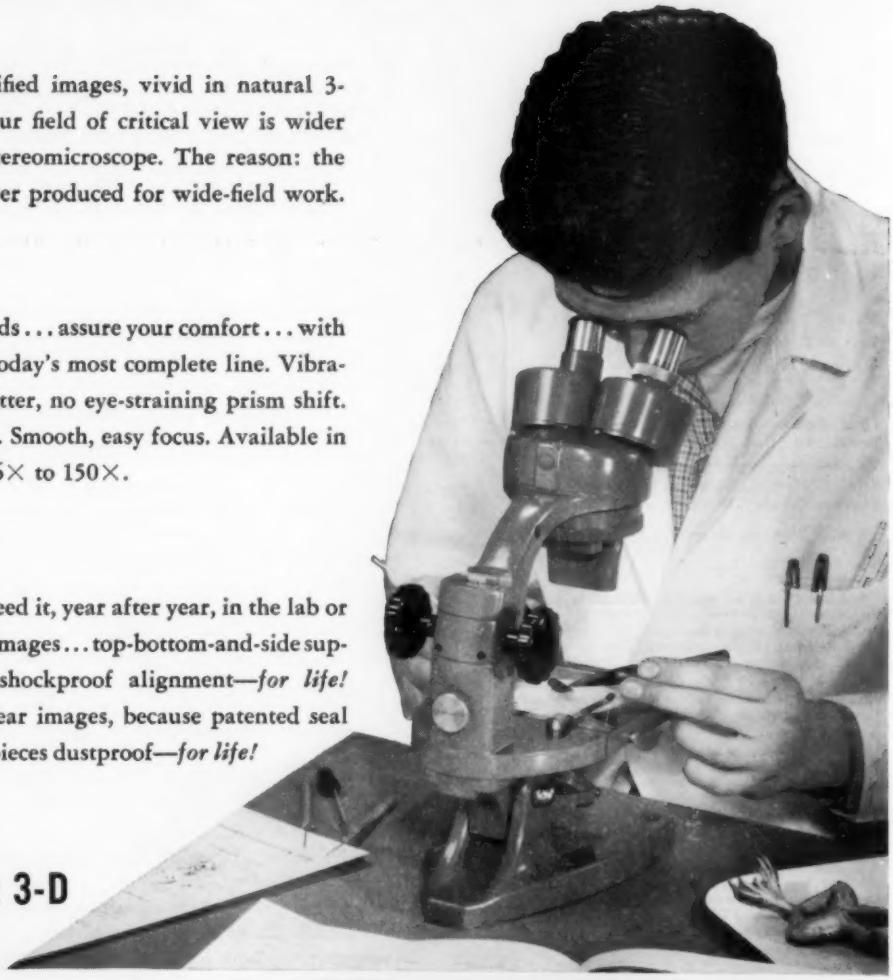

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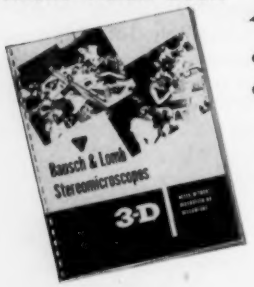

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High-Current Accelerators

Ernest O. Lawrence

It is hardly necessary to point out that the remarkable development of particle accelerators, like all far-reaching scientific and technologic advances, is the work of many people in many laboratories over the world. It was, for example, Cockcroft and Walton in England who first achieved the disintegration of lithium by accelerated protons, and it was Veksler of the Soviet Union who, in a classic paper on the theory of accelerators, was the first to describe the synchrotron, thereby pointing the way to much higher energies.

The bevatron at the University of California, which for the moment is the largest proton synchrotron, is shown in Fig. 1. The magnet is arranged in four quadrants and in the foreground may be seen the cavity-type linear accelerator, which serves to inject pulses of 10-Mev protons into the synchrotron. The radiofrequency accelerating electrode and its associated equipment are in the straight section on the right, while the target area is in the straight section opposite the injector area and hence is hardly visible in the figure.

Figure 2 is a limited view of the injector quadrant of the bevatron. On the right is shown the housing of the 500-kilovolt Cockcroft-Walton accelerator, the foreground shows the 10-Mev linear accelerator, and on the left can be seen the strong-focusing quadrupole magnetic lens, which focuses the beam appropriately into the bevatron.

Figure 3 shows the power supply of the bevatron, which provides 100,000-kilowatt pulses that are switched by the array of ignitrons shown in the foreground.

I shall not undertake a more detailed description of the bevatron. For some time now it has been in operation at full energy, 6.2 Bev.

I should like to note that this great machine is being utilized by scientists of many laboratories in America and abroad —indeed, about one-quarter of the operating time has been devoted to furthering work outside the United States. The many visiting scientists, especially from overseas, have been a real source of pleasure to all of us in Berkeley. Their presence has contributed greatly to the work in progress, and we appreciate even more the fact that their collaboration is increasing enormously the flow of new knowledge that the bevatron makes possible.

Of course, the finest flowering of this kind of international collaboration is embodied in the CERN Laboratory now being developed so auspiciously in Geneva by the European Organization for Nuclear Research.

It is perhaps an understatement to say that the richness of the domain of the nucleus opened up for investigation by accelerator developments has exceeded all expectations. Those of us who have had the good fortune to participate in these developments during the past quarter-century have, indeed, a vivid impression that each new door to a hitherto inaccessible region of nature that is opened by the development of an accelerator of new capabilities always leads to unexpected advances in knowledge of both scientific and technologic importance. It is, of course, for this reason that accelerator developments over the world are proceeding at an ever-increasing pace.

In his retiring address as president of the American Physical Society in 1954, Enrico Fermi humorously presented a logarithmic plot of the progress in accelerator developments toward ever higher voltages. He extrapolated the exponential progress of recent years to show that in a few more decades our accelerators would circle the earth and compete with very energetic cosmic rays!

In the same spirit, one may extrapolate the currents that will be produced (Fig. 4). Taking a milliampere for cyclotrons in 1940, a microampere for synchrocyclotrons in 1943, and a millimicroampere for the cosmotrons and bevatrons of 1956, we obtain a current of 5×10^{-4} particles per second or 2 protons per hour when our energy should reach 10^{16} electron volts!

In a more serious vein, it is clear that the duty-cycle limitation on beam currents imposed on all pulsed accelerators is a matter of concern. For it goes without saying that increasing beam intensities manyfold opens up new possibilities for research just as ever higher energy opens new domains of investigation. If, for example, 15 years ago cyclotron currents had been small fractions of microamperes, rather than many microamperes, the discovery of neptunium, plutonium, and other transuranium elements and their remarkable properties would surely have been delayed. Indeed, perhaps the United Nations International Conference on the Peaceful Uses of Atomic Energy in Geneva would not have been held! The problem of producing high currents of high-energy particles is unquestionably an important one.

Many people have given thought to this problem, and the story of their work is interwoven with that leading to higher energies. However, it is less well known to most physicists. It begins, at least for circular accelerators, with a paper published by L. H. Thomas in 1938 in which he showed that the energy limitations of an ordinary cyclotron (because of relativity mass increase with energy) can be overcome by inserting periodic azimuthal variations in the magnetic field so that the particle orbits depart from circular form, the departure being larger for the higher-energy orbits of larger radius. This work of Thomas received but little attention for a period of more than 10 years. This may be ascribed partly to the fact that the cyclotron people had all they could do to develop and exploit the simpler and more straightforward conventional cyclotron until they all became occupied with assisting in the defense of their various countries. After the war, it seemed simpler to raise cyclotron energies by using the principle of phase stability of Veksler and McMillan as embodied in the synchrocyclotron.

A few years after the war, however, at-

The author is director of the Radiation Laboratory, University of California, Berkeley. This article is based on a lecture that was given on the evening of 11 August at Geneva, Switzerland, during the United Nations International Conference on the Peaceful Uses of Atomic Energy.

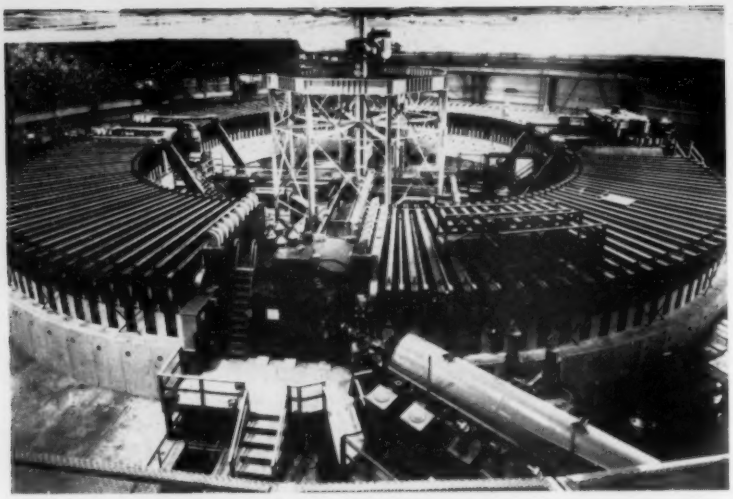

Fig. 1. General view of the bevatron.

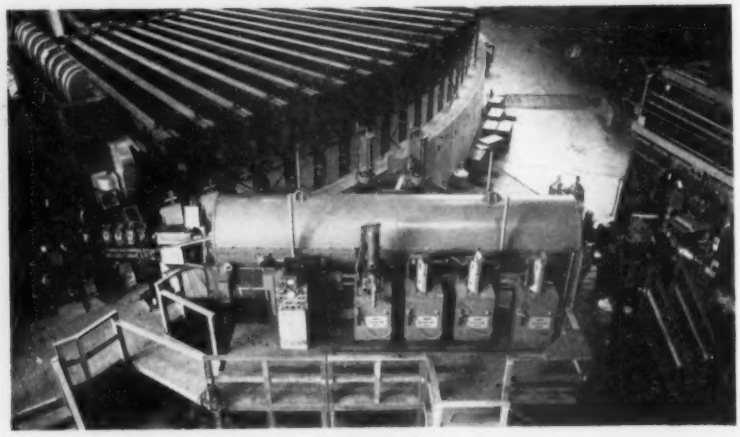

Fig. 2. Bevatron injector.

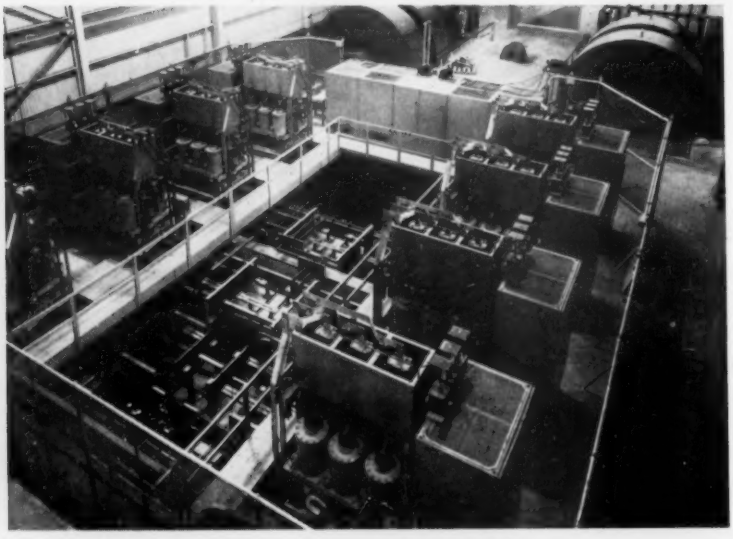

Fig. 3. Bevatron magnet power supply.

tention in our laboratory was drawn to the problem of producing high currents of particles accelerated to energies in the range reached by the synchrocyclotron, and in that connection my colleague McMillan came forward with an independent approach to the problem of a magnetic field that would be suitable for a high-energy cyclotron.

There is not space here to discuss the relationship of McMillan's solution to that of Thomas, although they were basically similar in providing an azimuthal variation in the magnetic field to achieve focusing. Nor is it possible to describe Judd's and later Richardson's contributions to the design of suitable fields, which made possible cyclotrons capable of continuous (in contrast to pulsed) operation with deuterons in the energy range above 700 Mev.

Figure 5 shows schematically the orbit of a particle in such a magnetic field which is a function of both azimuth and radius. Here n varies around the orbit as does the radius, so that the focusing action is partly due to the variation in radius, which produces focusing like that of a wedge-shaped magnet, while the variable n gives the effect of alternating-gradient focusing of Christofolis and of Courant, Livingston, and Snyder.

Now I should like to describe the experiments that have been carried out in our laboratory with an electron model of a cloverleaf cyclotron (so called because of the shape of the magnet pole pieces), which have so beautifully substantiated the theoretical expectations.

One of the pole faces of the magnet of the electron model is shown in Fig. 6. Here the magnet diameter is 40 inches, and the magnetic field chosen has a threefold symmetry.

Figure 7 shows a general view of the interior of the electron model. The variable magnetic gap is in view as well as one of the three accelerating electrodes that occupy the three wide-gap regions between the poles.

Now, in this electron model, where the electrons reach final velocities equal to that of 300-Mev deuterons ($\beta = 0.5$), the magnetic fields are small—only about 20 gauss—and inhomogeneities of the iron make it difficult to produce the desired magnetic field. The mechanical problem of shaping the pole pieces accurately is also quite severe, and consequently field-correcting coils are mounted on the pole pieces as shown in Fig. 8. As is seen, there are a considerable number of concentric coils to vary the average radial value of the field, while a number of coils in the valleys of the gap provide for azimuthal and radial variations.

With these orbit-correcting coils, it was possible to produce the desired field with the desired precision to tenths of 1 percent everywhere.

With a suitable electron gun at the

center, the model operated quite in accord with theoretical expectations. The measured threshold voltage to accelerate electrons was only 23 or 24 volts, which corresponded to the energy gain required for electrons to miss striking the electron gun. It is estimated that the electrons required 2000 or 3000 revolutions to reach their final energy of 70,000 volts. This corresponds in an actual accelerator to an electrode potential of about 100 kilovolts to accelerate deuterons to 300 Mev. Thus, it is clear that the Thomas-type field does indeed provide the necessary axial and radial stability and that, within the limits expected on theoretical grounds, the particles can stay in phase with the constant-frequency accelerating voltage.

It was observed that essentially the entire electron beam escaped from the machine in three divergent beams from each of the three hills, and by weakening the field on one of the hills, it was found possible to produce a beam containing 90 percent of the total circulating energy from the hill in question. By use of an external focusing magnet, the external beam could be converged, and all together it appeared that this type of cyclotron, which we called a cloverleaf cyclotron, had the admirable property of easy beam extraction along with high currents at high energy with very low voltages on the accelerating electrodes.

At this stage, I should like to draw attention to yet another approach to the problem of high-current high-energy cyclotrons, which is a by-product of the new and interesting set of proposals now under investigation by the accelerator design group of the Midwestern Universities Research Association (MURA), under the leadership of Kerst, whose interest lies primarily in the attainment of high energies in proton synchrotrons. Their work is so new that it has not yet been put to practical test, although they are now engaged in constructing an electron model accelerator that will explore some aspects of their proposals. It is based on the observations of Keith Symon that a proton synchrocyclotron can be built with a magnet of small radial extent like that of a synchrotron, provided that particles are injected with reasonable energy. This can be done by exploiting the alternating-gradient focusing with its well-known property of "momentum compaction" by which orbits of widely differing energies may be made to be very near each other in space. It certainly will be interesting to see whether such a scheme appears to be as attractive in practice as the alternating-gradient modulated magnets being employed by the Brookhaven and CERN groups for machines in the 20- to 30-Bev range.

The MURA group has introduced the idea of spiraling the hills and valleys of the magnetic field so that particle orbits cross them at a rather steep angle instead of perpendicularly. Applying these ideas to betatrons, they predict that using a greater flux change than necessary to attain the desired energy may free a betatron from its duty-cycle limitation and its current may be increased 10,000-fold! Moreover, with the spirally rigid poles, it is possible to arrange matters so that orbits of all energies are geometrically similar, with the frequencies of radial

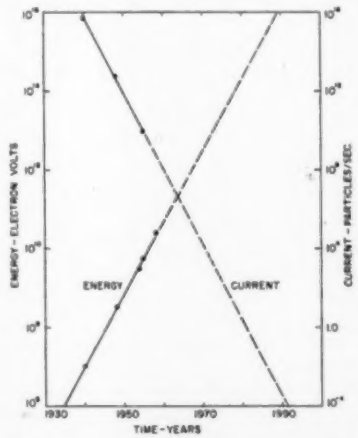

Fig. 4. Extrapolation of accelerator energy and current output.

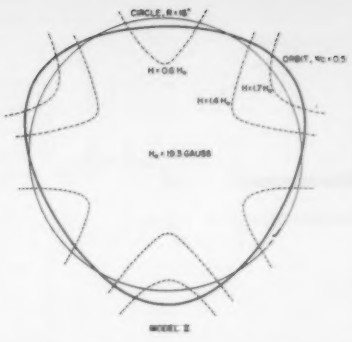

Fig. 5. Left, particle orbit in Thomas-type cyclotron field. Fig. 6. Right, electron model cyclotron pole face.

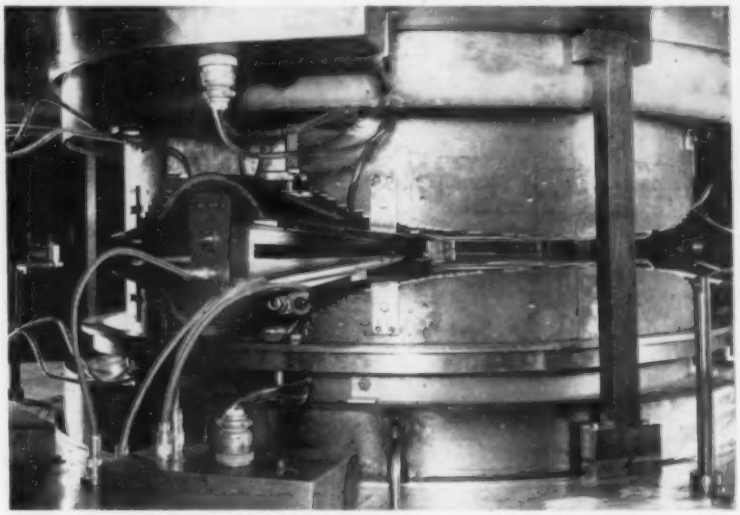

Fig. 7. Interior of electron model cyclotron.

Fig. 8. Electron model cyclotron pole face with field-correcting coils.

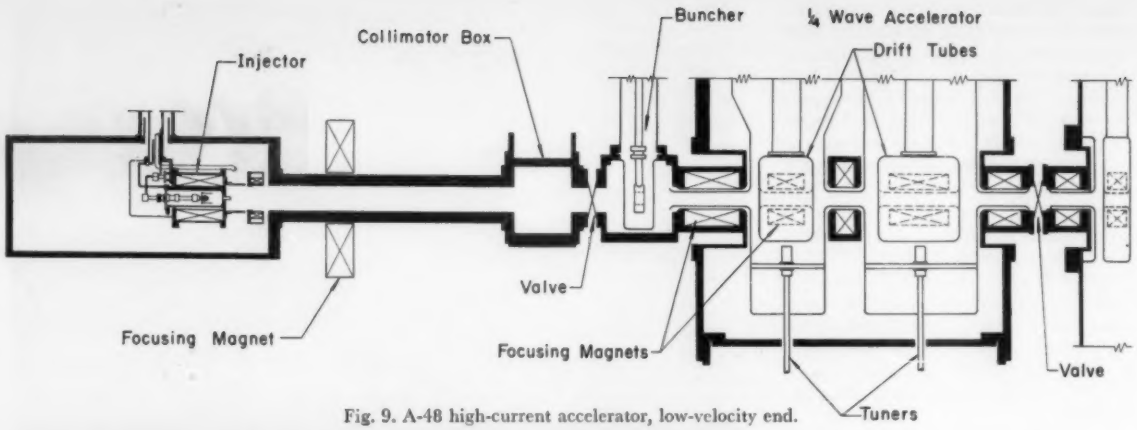

Fig. 9. A-48 high-current accelerator, low-velocity end.

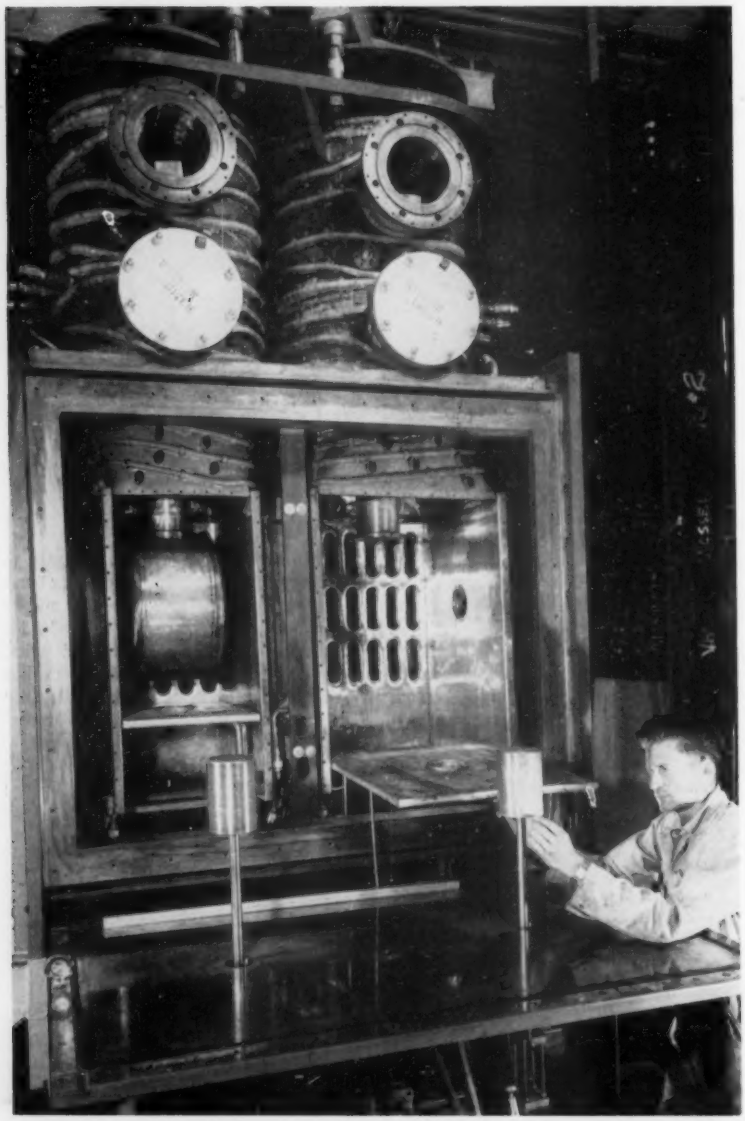

Fig. 10. Quarter-wave accelerator with one drift tube in place.

and axial oscillations remaining constant throughout the acceleration process. Therefore, in principle, troubles with resonance effects can be avoided. This MURA work, therefore, seems to constitute another improvement in the development of fixed-frequency cyclotrons.

All of this work has shown that the original energy limitations of the ordinary cyclotron can be surmounted in a variety of ways. This information can be applied directly to improve the performance or to lower the dee-voltage requirement on existing cyclotrons by simply reshaping the poles. This procedure has already been carried out under the direction of Keith Boyer on the Los Alamos cyclotron and has resulted in very satisfactory operation with a greatly reduced loss of particles during acceleration. The present reasonable energy limit for high-current cyclotrons producing currents of many milliamperes is not easy to establish, but it seems certain that it will increase with the development of accelerator technology that is certain to continue as long as physicists are interested in looking for new problems to solve.

Now I return to the accelerator development work in Berkeley during the last 4 or 5 years. Along with the development of the cloverleaf cyclotron, a greater effort was made in collaboration with the California Research and Development Company to develop the linear accelerator, of the cavity-resonator type devised by Alvarez, for high currents at high voltages. The over-all objective was what might be called a superpower particle accelerator capable of producing thousands of kilowatts of high-energy protons. The linear accelerator development appeared so promising that it was decided to abandon consideration of construction of a cloverleaf cyclotron, which would involve a very large capital expenditure, and to concentrate on the design and construction of a linear machine, the first sections of which would not entail too great a capital outlay and would

Fig. 11. Half-ampere, 100-kev proton beam entering input aperture of A-48 accelerator.

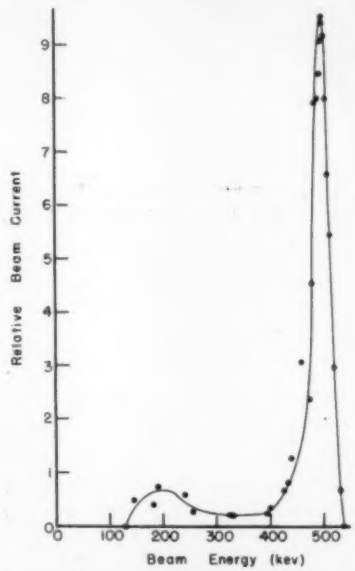

Fig. 12. Energy distribution of beam from quarter-wave accelerator.

allow extension almost indefinitely to higher voltage as desired in the future.

Of course, the first problem was a source of protons of many amperes from which could be withdrawn 100- to 200-kilovolt protons focused into a beam that would pass through an aperture of about 5 centimeters in diameter. After that there was the problem of accelerating the beam in a first stage to about half a million electron volts. Theoretical studies had shown that in a cavity-type accelerator operating at a frequency of 48 megacycles per second, where solenoid focusing was used in the drift tubes, there should be no great difficulty in accelerating such a 500-kilovolt beam on up to many hundreds of millions of volts with little loss and at comparatively high efficiency. In other words, the technical problem seemed essentially that of bringing a large current of ions up to about half a million volts or so, sharply focused and bunched for injection into the linear accelerator of the Alvarez type, which we call the A-48 accelerator.

The arrangement has worked out very well, as is shown in Fig. 9. At the left is the injector, consisting of an arc source in a solenoidal magnetic field mounted on insulators in a vacuum tank. The arc body is maintained at a positive potential up to 140 kilovolts and has produced up to ¾ ampere of focused ion beam. Ions produced in the arc are accelerated by a single gap through a 4-foot length of beam tube and are brought to a focus on a collimating aperture by a large solenoidal magnet, through which the beam tube passes. The diameter of the ion beam is controlled by varying the magnet current, and the centering of the ion beam is controlled by orienting the magnet, which is flexibly mounted.

Just beyond the collimating aperture, the ion beam passes through the buncher, which applies a 24-megacycle ripple of 5 to 7 kev to the beam. As a result, a large fraction of the ions arriving at the first radiofrequency accelerating gap are bunched into a small phase angle of the 24-megacycle wave.

The next component shown is the 24-megacycle quarter-wave accelerator. This machine consists of two quarter-wave resonant stems, the ends of which are drift tubes for 24-megacycle acceleration. Each drift tube and stem is housed in a separate cavity to reduce to a minimum the coupling between them. The gap spacing for each drift tube is $(3/2)\ \beta\lambda$ and that between the two cavities is $1\ \beta\lambda$, so that ideally the two stems should operate 180 degrees out of phase. Actually, the two stems and the buncher are all separately driven and the phases between them are adjusted for optimum output.

In each drift tube and at positions before, between, and after the drift tubes, solenoidal magnets are located as shown to maintain beam focus throughout. Figure 10 is a view of the quarter-wave accelerator with one drift tube in place.

Deuterons are accelerated by the quarter-wave machine from 140 kev to about 1 Mev, for which energy the velocity is great enough that the frequency can be increased from 24 to 48 megacycles per second for subsequent acceleration.

Figure 11 shows the ion beam from the injector as it passes from the beam tube into the collimating aperture. When this photograph was made, a continuous beam of about ½ ampere of 100-kev protons was being injected through a 2.5-

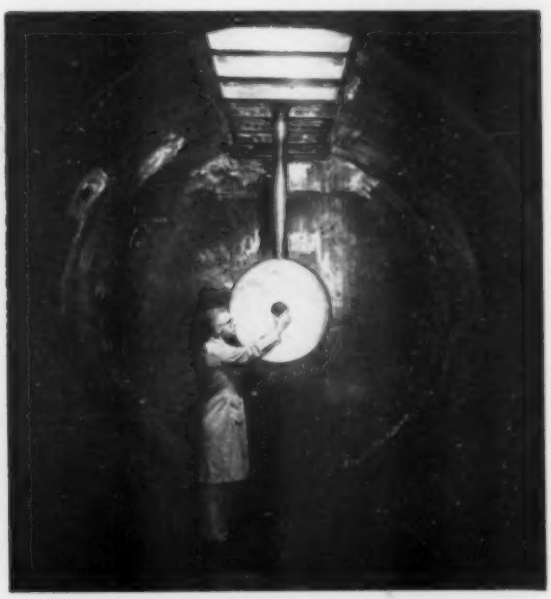

Fig. 13. Left, interior view through side porthole of A-48 cavity. Fig. 14. Right, interior view of A-48 cavity through the beam output port.

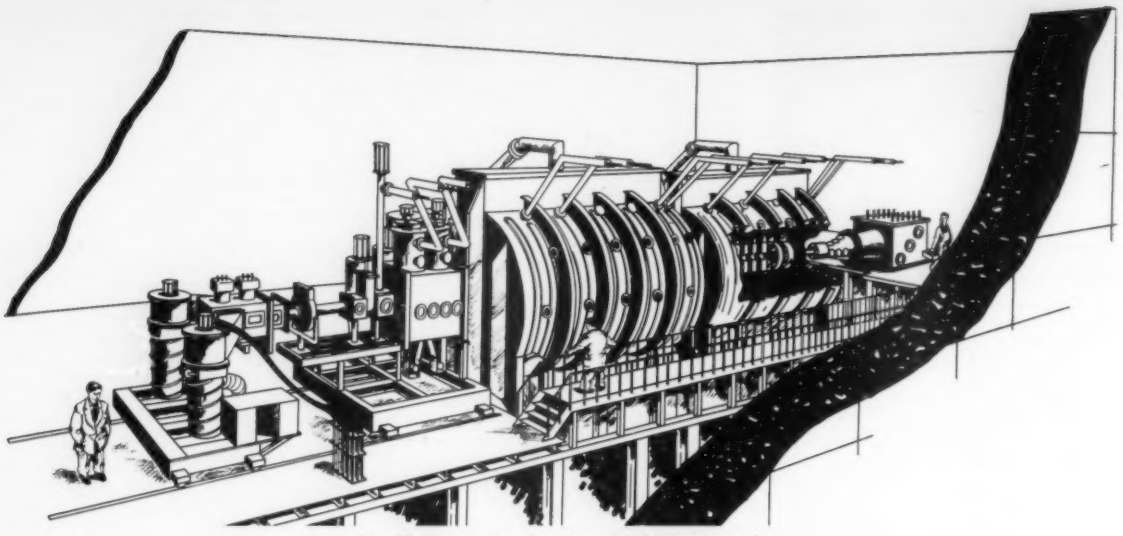

Fig. 15. Perspective drawing of A-48 accelerator.

inch-diameter collimating aperture into the accelerator.

This part of the A-48 accelerator operates continuously and smoothly, delivering several hundred milliamperes of ½-million-volt protons or 1-million-volt deuterons, thus several hundred kilowatts of nicely focused ions reach a target about 1 meter from the last accelerator electrode.

The beam, of course, is bunched into short pulses (less than 10^{-8} second), and the instantaneous currents therefore are of the order of 1 ampere. The energy distribution in the beam when protons are accelerated is shown in Fig. 12. It is seen that most of the beam is close to the desired energy and indeed is very close to theoretical expectations.

We are now building two sections of the A-48 accelerator to produce ¼ ampere of 7.8-Mev deuterons. Figure 13 is a view of the interior of one of the 20-foot cavities looking in through a porthole in the side. The drift tubes are viewed from below and off to one side. The cavity tank is fabricated of copper-clad steed, the drift tube shells of copper sheet, and the supporting stems of heavy-wall steel tubing, copperplated on the exposed surfaces. Figure 14 is another view looking down the line of drift tubes, showing the aperture through which the beam passes. The drift-tube volume is much larger than the beam aperture because of space requirements for water cooling and solenoidal focusing magnets.

The general arrangement of the A-48 high-current accelerator is shown in a perspective drawing, Fig. 15. At the left are located the ion injector, the beam-focusing and steering magnet, the 24-megacycle buncher, and the quarter-wave accelerator as previously described.

The deuteron beam at 1 Mev from the quarter-wave accelerator then enters the first of two 48-megacycle resonant-cavity acccelerator sections, each 20 feet long. A portion of the side wall of the second cavity is cut away to show the drift tubes and supporting stems. As I have already mentioned, each drift tube contains a solenoidal magnet for maintaining beam focus throughout the machine. The gap spacings in both resonant cavities are 1 $\beta\lambda$; that is, the ions receive one accelerating impulse during each radiofrequency cycle.

Since the design deuteron current output at 7.5 Mev is 0.25 ampere, the target system is designed to dissipate 2 megawatts of beam power. To prevent excessive power concentration at the target, the ion beam passes through a rotating magnetic field at the exit aperture so that the beam is slightly deflected and processed over a target spot up to 3 feet in diameter. The target consists of a bank of overlapping tubes of aluminum, magnesium (Dow metal), or other metal with high-velocity water flow to insure good heat transfer.

The construction of this superpower accelerator is well along, and we expect that it will begin operation next year. A recent photograph of the present stage of construction is shown in Fig. 16. I cannot help but wonder what new knowledge will come from the availability in the laboratory of these very high currents of high-energy particles. Just as it is certain that new things of great interest will indeed turn up, so we may be confident that plans will go forward to build additional accelerating sections for this machine for ever higher voltages.

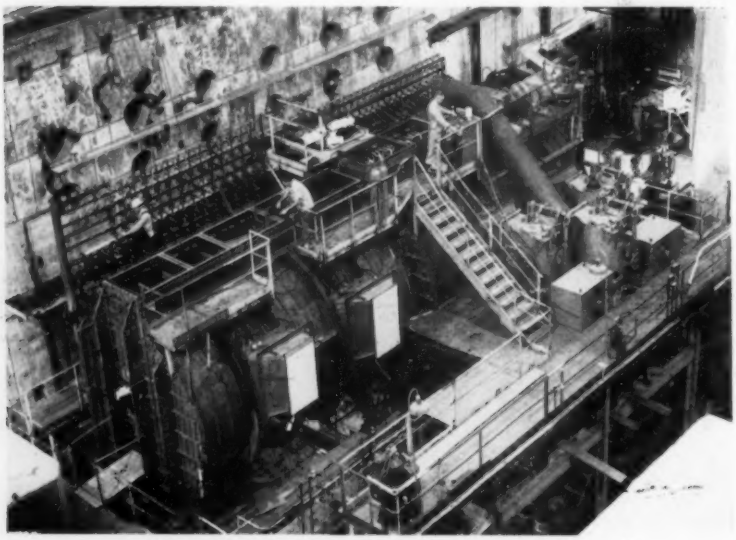

Fig. 16. View of A-48 accelerator during construction.

News of Science

Science Reporting

In view of the current concern about the responsibility of scientists for keeping the public informed about scientific progress and at the same time for maintaining accuracy and avoiding the stigma of the publicity seeker (see the editorial in *Science*, 12 Aug.), there should be considerable interest among scientists in the article by Gwinn Owens, science writer, in the November *Johns Hopkins Magazine*. Interpreting science to laymen, says Owens, is primarily a problem of accurate translation. The scientist must recognize the nature of the audience, which necessitates that the story first of all be interesting if it is to be news at all.

There is also the question regarding what the public has the *right* to know. This grows not only out of the fact that what the scientist is doing in the laboratory may change the layman's life, but also out of the fact that the public, directly or indirectly, is paying for the research. At the same time, the scientist must resist pressure upon him to speak of results prematurely—he must never allow impatience for "results" on the part of the public to lead him to jump the gun and raise hopes falsely.

Owens agrees with the editorial writer of the *Southern Medical Journal* who has criticized the "debacle" of the publicizing of the poliomyelitis vaccine last spring, insofar as misinterpretation of the reports of the trial use of the vaccine and the right of the investigator to control his own investigations may be concerned; but he holds also that the editorial writer missed an important point in not recognizing "the urgent need for popular understanding and support if large-scale, non-government research is to survive in this country." Popular articles on research bring the pennies that amount to millions of dollars for research in medical fields.

The crux of the discussion, then, is the question: "How do we bridge the gap between the scientist and the interested public?" Owens suggests that there is no better way than close collaboration between the scientist and the reporter. "The scientist's part is to make sure that the reporter understands the project thoroughly. This may mean simplifying technical terms and descriptions of procedures. Chances are, the reporter knows something about the work, for essentially he is a middle man. He knows less than the professional, but more than the potential reader."

Owens feels that the scientist is often oversensitive about the use of terms that seem "imprecise" or even inaccurate; or is too unwilling to admit practical benefits even where these exist. On the other side, the reporter has the responsibility for telling the truth to the public, and must not actually distort it.

This article raises a number of other interesting problems. What it does not clarify is how the necessary collaboration between a busy scientist and a busy reporter is to be worked out. What are the minimum provisions that will insure accuracy of account, interest and timeliness in the report, and fair treatment on all sides?—B.G.

News Briefs

■ The University of Chicago's Institute for Nuclear Studies became the Enrico Fermi Institute of Nuclear Studies in ceremonies honoring the memory of Fermi that took place on 18 Nov. A portrait of Fermi was displayed for the first time. It is the work of Mrs. Alex Langsdorf, whose husband is a nuclear physicist at Argonne National Laboratory.

■ For the second time in 18 months the Air Research and Development Command's Air Force Cambridge Research Center will sponsor an intensive study of a solar eclipse. Some 63 scientists, technicians, and airmen, representing a dozen agencies, have left the United States for observation posts in Africa, Ceylon, Burma, Thailand, Viet Nam, and Formosa, where they will study an annular eclipse that will take place on 14 Dec.

Advance parties from the American Geographical Society of New York already have charted the stations where special instruments are being set up. Project scientist for the forthcoming observations is Robert Fitzpatrick, geophysicist with the Terrestrial Sciences Laboratory, Geophysics Research Directorate, AFCRC.

Working closely with Fitzpatrick during the past 6 months have been a number of agencies with long experience in the scientific observation of solar eclipses. Among them are the Georgetown University Observatory of Washington, D.C., headed by Francis J. Heyden, the American Geographical Society of New York, and the Air University Arctic-Desert-Tropic Information Center of Maxwell Air Force Base, Montgomery, Ala.

Specialists from a number of universities also will take part in the observations. Teams of astronomers will man stations at 11 sites along the path of the eclipse. The research groups will include men from Georgetown University, University of Pittsburgh, Indiana University, Milwaukee Astronomical Society, Johns Hopkins University, Pennsylvania State University, Swarthmore College, University of North Carolina, Loyola University, Ohio State University, and Yale University.

The determination, as exactly as possible, of the shape and size of the earth is the main purpose of the eclipse expedition. By determining the exact difference in the time of the occurrence at different sites, it is possible to determine the distance between the sites.

Two methods will be used to take measurements; the first, a photographic method, consists of photographing the sun's image during the onset of the eclipse. At the same time that the picture is taken a radio time signal is recorded so that the time of the photograph is known to within 1 millisecond. After the return of the expeditions, all photographs will be measured (there will be 500 pictures from each site), and the exact time of any given phase of the eclipse can be determined.

In the second method a photoelectric cell will be trained on the sun. By means of electronic amplifiers and recorders, an ink record of the variation of light during the eclipse will be obtained. This record is also made simultaneously with an accurate radio time signal, so that the exact time of any phase can be determined. The entire eclipse will last about 2 hours, from its beginning in Africa to its ending just north of Formosa.

■ Workmen began pouring concrete on 17 Nov. for India's Bhakra Dam, which may be the world's highest when it is finished in 1961 or 1962. Pouring of the concrete is scheduled to continue nonstop for 4 years until the dam stands more than 700 feet—possibly 750 feet—above the bed of the Sutlej River.

Bhakra Dam, key construction in a $327-million Bhakra-Nangal irrigation and power project, is rising in a gorge of the Sutlej River in the Himalayan foothills 225 miles north of New Delhi. When completed, Bhakra will have a capacity of 900,000 kilowatts.

India is paying the cost. American

engineers, led by Harvey Slocum of Alhambra, Calif., have been employed by the Indian Government as advisers. Some 30 to 40 Americans have assisted in the preliminary construction and planning during the past 3 years.

Slocum, who has been construction chief at such United States dams as Shasta and Grand Coulee, describes Bhakra as probably the most difficult dam ever undertaken. He says that this is because of the remoteness of the site, the geologic formations in the gorge, and the lack of sufficient trained personnel to supervise the work force of more than 70,000.

Preparation of the site has taken years. The gorge was scraped, diversion dams and tunnels were built to route the Sutlej around the dam site, railroads were constructed to carry the concrete from the mixing plants, conveyor belts were installed, and floodlights were set up for 24-hour operation.

■ Successful clinical trial of an experimental vaccine against one type of common respiratory illness has been announced jointly by the U.S. Public Health Service and the Johns Hopkins Medical Institutions. Experiments indicate that the vaccine provides substantial protection for human beings against one of the nine viruses in the APC (adenoidal, pharyngeal, conjunctival) group, a family of respiratory viruses discovered several years ago.

The research, conducted with human volunteers, dealt with type 3 APC virus, which causes a 5-day illness marked by fever, sore throat, and conjunctivitis. The illness can be sporadic or occur in sharp outbreaks or epidemics.

Diseases of the upper respiratory tract are so widespread that the average American experiences an estimated six attacks each year. Studies have shown that 40 to 50 percent of the persons who are absent from their jobs because of illness are incapacitated by common respiratory diseases. APC infections represent only one part of this problem.

The research team emphasized that its work is still in the preliminary stage and that the vaccine is purely experimental. There is no plan to produce the vaccine for public use in the near future.

Results of the studies, indicating substantial protection by the vaccine against induced infection, are reported in the 5 Nov. issue of the *Journal of the American Medical Association*. The authors are R. J. Huebner, J. A. Bell, W. P. Rowe, T. G. Ward, R. G. Suskind, R. S. Paffenbarger, and J. W. Hartley. All are Public Health Service investigators with the exception of Ward, who is associate professor of microbiology at Johns Hopkins University School of Hygiene and Public Health.

Serving as volunteer subjects for the vaccine tests were 83 inmates of the Federal Reformatory at Chillicothe, Ohio, and the Maryland State Reformatory for Males at Breathedsville. The two institutions have been cooperating with research workers for the past 2 years in respiratory virus studies that laid the groundwork for the vaccine trial.

■ With the publication of the November 1955 issue of the *American Annals of the Deaf*, the 100th volume of this journal was completed. The journal was founded in 1847 at the American School for the Deaf in Hartford, Conn., but publication was suspended during the Civil War and was not resumed until 1868, when the editorial office was located at Gallaudet College, the national college for the deaf in Washington, D.C., where it has since remained.

American Annals of the Deaf is the official organ of the Convention of American Instructors of the Deaf, founded in 1850, and of the Conference of Executives of American Schools for the Deaf, founded in 1868. According to the Library of Congress, the *Annals* is probably the oldest educational journal in the United States, and is the oldest publication in the world on the education of the deaf.

The entire scope of educational work for the deaf in the United States and Canada has expanded greatly since the close of World War II. The plight of the war-deafened veterans, the increased use of electronic amplification in hearing aids, the growth of the preschool movement in schools and classes for the deaf, and the rapid development of services for parents of deaf and hard-of-hearing children during the past 10 years awakened great interest in the education of the deaf. Because of this increased interest, with the accompanying expansion in the publication of textbooks, newspaper articles, magazine articles, and radio and television programs, Powrie V. Doctor, editor of the *American Annals of the Deaf*, has felt it advisable to call attention to the resources that are obtainable through the journal's office.

Scientists in the News

MAX F. DAY of the Division of Entomology, Commonwealth Scientific and Industrial Research Organisation of Australia, has been appointed for 2 years to the Australian Scientific Liaison Office, Washington, D.C. Day, who obtained his doctorate at Harvard University, was in the Liaison Office during World War II.

LEO KANNER, professor of psychiatry and pediatrics at Johns Hopkins University and director of the children's psychiatric service at the Johns Hopkins Hospital, will serve as Knapp visiting professor at the University of Wisconsin in the second semester of the current academic year. During his stay at Wisconsin he will teach in the medical school, deliver several public lectures, and lead discussions on child behavior. Kanner is the author of a large number of both technical and popular works on child psychiatry, among them *A Miniature Textbook of Child Psychiatry*, and articles dealing with psychiatry, psychology, education, medical history, and folklore.

LEWIS H. WRIGHT, an anesthesiologist and a member of the staff at E. R. Squibb and Sons for more than 25 years, has been named to receive the 1955 Distinguished Service award of the American Society of Anesthesiologists. The announcement was made at the recent annual meeting of the society in Boston, Mass., a meeting that marked the organization's 50th anniversary.

WILLIAM E. RANZ, associate professor in engineering research at Pennsylvania State University, received the 1955 Junior Award in chemical engineering from the American Institute of Chemical Engineers during its annual banquet on 29 Nov. He was honored for his paper "Friction and transfer coefficients for single particles and packed beds," which was published in *Chemical Engineering Progress* in 1952.

ELVIN C. STAKMAN, emeritus professor of plant pathology at the University of Minnesota and a former president of the AAAS, has been serving as Hitchcock professor at the University of California, Berkeley. The six public Hitchcock lectures have been concerned with various aspects of plant disease, the world's food supply, international cooperation in scientific research, and scholarship in the academic world today.

K. H. GUSTAVSON, head of the Swedish Tanning Research Institute, Stockholm, has received the IVA grand gold medal, the highest award of the Royal Swedish Academy of Technical Sciences (IVA). He was honored for his pioneering contributions to the chemistry and reactivity of collagen and for his investigations of the mechanism of tannage, particularly his research on the reaction of chromium compounds with hide protein in chrome tanning.

Gustavson is president of the International Union of Leather Chemists' Societies. He has been a member of the American Chemical Society for 35 years and worked in this country as a leather chemist for many years.

HENRY RINDERKNECHT, formerly of Crooks Laboratories, England, has joined the staff of the California Foundation for Biochemical Research, Los Angeles, as director of the organic research division.

BRUNO VASSEL, former supervisor of organic and biochemical research for the International Minerals and Chemical Corporation at Skokie, Ill., has been named director of research for Johnson and Johnson Do Brasil in São Paulo, an affiliate of Johnson and Johnson, New Brunswick, N. J. Vassel has been particularly active in the fields of protein isolations; monosodium glutamate processes; amino acid analyses and syntheses; pharmaceuticals; polarograph; flotation reagents; detergents; and starch derivatives.

VICTOR CONQUEST, vice president of Armour and Company, who has directed the company's research activities in Chicago since 1931, has been named recipient of the Industrial Research Institute medal for 1956. The medal has been awarded annually since 1945 to honor "outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare." Formal presentation of the medal will be made next April at the institute's annual meeting in White Sulphur Springs, W. Va.

Conquest's original department consisted of 15 persons; the Armour technical staff now has more than 400 members. They have developed hormone and enzyme products including ACTH, from meat animals, chemicals made from fats, and many other products.

RICHARD M. HERMES, formerly with International Business Machines, has joined the staff of Stanford Research Institute as a senior research engineer in the control systems laboratory. He will work on the design of electromechanical controls for paper-handling and electronic data-processing systems.

OLLE RIMER, a Swedish industrial engineer, has been assigned by the United Nations Educational, Scientific and Cultural Organization to teach engineering at the Indian Institute of Technology in Kharagpur. Rimer is on leave from his post as assistant professor of industrial engineering at the Royal Institute of Technology and the Chalmers Institute of Technology, Stockholm. The third Swedish national to be sent to India by UNESCO on a technical assistance mission, Rimer will join an international team of scientists that has been working with the Indian Institute of Technology since 1951.

DEAN W. ROBERTS of Baltimore, Md., medical administrator, physician, and leader in the field of public health, has been appointed executive director of the National Society for Crippled Children and Adults, Chicago, Ill. Roberts, since 1952 director of the National Commission on Chronic Illness, will succeed LAWRENCE J. LINCK, who has been executive director of the National Society since 1945.

F. REINHARD, former director of the department of pharmacology for Mead Johnson Research Laboratories, has been appointed director of pharmacologic research at Baxter Laboratories, Inc., Morton Grove, Ill.

DONALD V. SARBACH has been appointed to the newly created position of research director of Hewitt-Robins, Inc., Stamford, Conn. He will be a member of the company's executive staff in Stamford and will serve in an advisory capacity to technical and research departments at manufacturing plants in Buffalo, N.Y.; Passaic, N.J.; Fremont, Ohio; and Chicago, Ill. Sarbach was previously associated with the B. F. Goodrich Company, Akron, Ohio, where he was technical manager for development of new industrial products.

RALPH A. ALPHER, since 1944 a physicist at the Applied Physics Laboratory, Johns Hopkins University, has joined the chemistry research department at the General Electric Research Laboratory, Schenectady, N.Y.

EDWARD MACK, since 1941 chairman of the department of chemistry at Ohio State University, has asked to be relieved of the chairmanship in order to devote himself to teaching and research. HARVEY V. MOYER will serve as acting chairman until a permanent appointment has been made.

The following appointments to assistant professor have been announced. Southern Illinois University: EDNA DUDGEON, zoology (genetics); HOWARD J. STAINS, zoology (mammalogy). Massachusetts Institute of Technology: MELVILLE CLARK, JR., chemical engineering.

Necrology

THEODORE BELZNER, Brooklyn, N.Y.; 76; retired civil engineer; 18 Nov.

E. STEUART DAVIS, Southampton, N.Y.; 73; early developer of lighter-than-air craft; 17 Nov.

CHARLES W. EDWARDS, Durham, N.C.; 81; retired professor of physics, Duke University; 17 Nov.

EDWIN KIRK, Washington, D.C.; 70; paleontologist and geologist who served with the U.S. Geological Survey from 1909 until his retirement in January 1955; 16 Nov.

JOSEPH LILIENTHAL, Baltimore, Md.; 44; head of the environmental medicine department at Johns Hopkins School of Hygiene and Public Health; 19 Nov.

ROBERT K. PHELAN, Germantown, N.Y.; 46; bacteriologist and chemist; president of Taconic Farms, Inc.; 17 Nov.

OSCAR RAGINS, Chicago, Ill.; 62; clinical associate professor of medicine at the University of Illinois Medical School; 19 Nov.

GERHARD ROLLEFSON, Berkeley, Calif.; 55; professor of chemistry at the University of California; 15 Nov.

GERALD WILLARD, Fanwood, N.J.; 54; retired physicist of the technical staff of Bell Telephone Laboratories, Murray Hill, N.J.; 18 Nov.

Education

■ Seventeen of Britain's largest firms have established a fund of more than $4 million to stimulate scientific education in secondary schools. With the rapid growth of the electronics and nuclear industries, it is felt that the country must be assured an adequate flow of scientists and technologists for the future.

Aid will take the form of capital grants for the building, expansion, modernization, and equipment of science buildings in independent schools and other schools that lack public funds. The fund will assist the teaching of pure and applied science and mathematics in secondary schools of this type.

Among the firms contributing are Rolls Royce, English Electric, I.C.I., Courtaulds, and Shell Oil. Among them, these companies have contributed approximately $4.2 million, but it is expected that this sum will grow as more firms join the fund. A statement from the fund members says "it is believed that many other companies that depend on adequate supplies of pure and applied scientists and technologists will wish to add their support, in their own as well as the national interest. . . ."

■ Last month the University of Chicago organized a special tour that represented a contribution of the university toward overcoming the country's shortage of scientists. In 13 major laboratories of the Institutes for Basic Research, faculty members demonstrated their current investigations to more than 400 science students, teachers, and principals from high schools in the Chicago area.

"It is a matter of critical importance, perhaps of survival, that the United States develops more highly trained scientists," Warren Johnson, dean of the di-

vision of physical sciences, said in describing the tour. "If we can stimulate the interest of students by exposing them to the methods and tools of research, and pass on some of the excitement and satisfactions of scientific investigation, we will be making a real contribution to America's future."

■ A $2 million aeronautical research laboratory is nearing completion at the University of Michigan. Wilbur C. Nelson, chairman of the university's aeronautical engineering department, reports that the laboratory will be one of the most flexible and versatile educational and research facilities in the nation for the study of aerodynamics and aerothermodynamics.

The four units of the new establishment are the aerodynamics laboratory, aircraft propulsion laboratory, air pumping station, and the power shed. The sections of wind tunnels for subsonic, supersonic, and hypersonic research will be housed in the aerodynamics laboratory.

■ The Woodrow Wilson School of Public and International Affairs at Princeton University is offering an undergraduate seminar this year on the relationship of government to science. John Turkevich, Eugene Higgins professor of chemistry and a Government consultant, is directing the seminar. It includes a discussion of the principles of atomic and nuclear phenomena, international atomic energy control, the history of the Atomic Energy Commission, and the relationship of the Congress to the commission and of the commission to industry.

The seminar meets once a week and a student reports on a phase of the subject assigned to him. A notable feature is the presence of a visiting authority, either from Government or industry, who is engaged in the activity under discussion.

Grants, Fellowships, and Awards

■ For the tenth consecutive year Case Institute of Technology will offer 50 all-expense General Electric science fellowships to enable preparatory-school and high-school physics teachers from the north central states to participate in a special 6-week study program that will run from 17 June through 27 July 1956. Applicants for the fellowships, which are sponsored by the General Electric Company, must be college graduates who possess experience in preparatory or high-school teaching; they must be certified to teach in their respective states.

The program is open to qualified teachers from Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, Minnesota, Ohio, Western Pennsylvania, Tennessee, West Virginia, and Wisconsin. Traveling expenses to and from Cleveland, Ohio, as well as the cost of living on the Case campus, books, tuition, and fees are included in each fellowship grant.

Purpose of the program is two-fold: to provide preparatory and high-school science teachers with a comprehensive review of the physical sciences, and to present an introduction to the most recent developments in nuclear physics. Two afternoons each week are spent visiting research centers in the Cleveland area such as General Electric's Nela Park Laboratories and the NACA Lewis Flight Propulsion Laboratory. Applications for the fellowships may be obtained from Dean Elmer Hutchisson, Case Institute of Technology, 10900 Euclid Ave., Cleveland 6, Ohio.

In addition to the study program at Case, the General Electric Company will also offer summer courses for high-school mathematics teachers at Rensselaer Polytechnic Institute; a summer program for high-school mathematics teachers at Purdue University; and summer courses for secondary-school chemistry and physics teachers from northeastern states at Union College.

■ In recognition of the contributions to science of Selman A. Waksman, a postdoctoral fellowship in the natural sciences related to the fields of medicine and health has been established at Rutgers University by the Chemical Division, Merck and Company, Inc., Rahway, N.J.

The Waksman-Merck postdoctoral fellowship is open to citizens of the United States or Canada who have received, or are about to receive, the Ph.D. or equivalent degree and who are interested in further training and research experience in biochemistry, chemistry, entomology, microbiology, nutrition, physics, physiology, or zoology as related to medicine and health.

The award is $4000 for one calendar year, beginning 1 July 1956. The closing date for receipt of applications is *10 Jan. 1956*. Application forms may be obtained from Dean of the Graduate School, Rutgers University, State University of New Jersey, New Brunswick, N.J.

■ The Bermuda Biological Station is continuing its program of grants-in-aid to assist scientists who wish to conduct research in Bermuda. These grants are supported by the National Science Foundation. Funds will be awarded primarily to pay for research space, living expenses, or for special collecting facilities required by a person who is working at the station. Applications for aid in purchasing equipment or for necessary travel expenses may also be considered.

A booklet describing the particular advantages and facilities of the Bermuda Biological Station will be sent on request. Formal application for research support should be made as far in advance as possible. For information write to the director, Dr. William H. Sutcliffe, Jr., Bermuda Biological Station, St. George's West, Bermuda.

■ The Commonwealth Fund, New York, convinced of the compelling need for medical schools to clarify their educational objectives in the postwar world and to help them to institute or to maintain creative programs in medical education, has announced the award of $7,150,000 drawn from its capital funds. This amount was appropriated as unrestricted grants to ten university medical schools. The urgency of the present need led the fund to make these special grants from capital in addition to the $2 million already given to medical education from its income in the fiscal year 1954–55.

It is expected that the special awards will enable the ten medical schools to make faster progress than would otherwise be feasible in this period when medical educators are reexamining their educational structure. It is hoped that the fund's action will stimulate similar unrestricted giving from other sources.

Medical schools receiving the grants were Chicago, $500,000; Columbia, $750,000; Cornell, $750,000; Emory, $600,000; Harvard, $1 million; New York University, $750,000; Southern California, $300,000; Tulane, $750,000; Western Reserve, $1 million; Yale, $750,000.

The Commonwealth Fund was established in 1918 by Mrs. Stephen V. Harkness with the motto, "To do something for the welfare of mankind." In recent years the fund's primary interests have been in the health field, particularly in medical education, medical research, and community health.

■ The Atomic Energy Commission has made available a number of special fellowships for the academic year 1956–57 in two relatively new fields of scientific endeavor that are closely related to the atomic energy program—radiological physics and industrial hygiene. The Oak Ridge Institute of Nuclear Studies will administer the fellowships for the AEC.

The radiological physics program provides for an academic year of formal courses at one of three universities to which fellows may be assigned; this is to be followed by transfer to a corresponding cooperating AEC installation where fellows will train for approximately 3

months in applied health physics. The three centers of the program are at the University of Rochester, in cooperation with Brookhaven National Laboratory; the University of Washington, in cooperation with the Hanford Works; and Vanderbilt University, in cooperation with Oak Ridge National Laboratory.

The programs at all three centers will include training in modern physics, radiation biology, radiation instrumentation, industrial hygiene and toxicology, biology, and research. As many as 25 fellows may be appointed in each of the three programs.

Industrial hygiene fellows will attend either Harvard University or the University of Pittsburgh. Course work will vary with the university selected and with the interests and undergraduate preparation of the individual. All fellows will be required to take course work in public health and biostatistics; electives may include engineering, health physics, toxicology, industrial medicine, and related subjects.

Basic stipend for AEC fellows is $1600, with an additional $350 allowed for spouse and $350 for each dependent child. Fellowship awards include payment of normal tuition and fees required by the university, and a travel allowance of 6 cents per mile for the fellow (not dependents) from the place of application to his assigned university. Radiological physics fellows receive an allowance for travel between the university and the cooperating laboratory. Industrial hygiene fellows are assisted financially to attend the annual meeting of the American Industrial Hygiene Association. One or more years of graduate work or industrial experience may qualify an industrial hygiene fellow for an additional $200 in the basic stipend.

A fellowship applicant may designate his choice of institution; when possible, assignments will be made accordingly, but ORINS cannot guarantee compliance with the choice. Requirements for AEC fellows include a bachelor's degree in physics, chemistry, or engineering, acceptability for graduate work at the university to which the fellow is assigned, and United States citizenship; applicants must be under 35 years of age. Radiological physics fellows should have minors in mathematics, biophysics, or similar fields; (however, applicants with other qualifications may be considered in special circumstances).

Additional information and application blanks may be obtained from the Fellowship Office, University Relations Division, Oak Ridge Institute of Nuclear Studies, Box 117, Oak Ridge, Tennessee. Completed applications, supporting letters of reference, and transcripts must reach the institute *not later than 1 Mar. 1956.*

In the Laboratories

■ Cornell Aeronautical Laboratory celebrated its tenth anniversary 30 Nov.–2 Dec. Highlight of the 3-day event was the dedication of two recently completed research facilities—a two-story addition and a three-story new building. Cornell Aeronautical Laboratory, Inc., is a self-supporting affiliate of Cornell University dedicated to research in the aeronautical sciences. The laboratory is a nonprofit organization; earned fees are used for further research or for educational benefits.

At its initiation in 1946 the laboratory had 600 employees and a few government contracts that totaled about $1 million. Today there are nearly 1200 employees and a $13-million backlog of research contracts. From five departments in 1946, the technical organization has expanded its interests to include ten technical departments.

More than 400 engineers and scientists are engaged in research at the laboratory. About 95 percent of laboratory work is for the Government, most of it classified. The research program is extremely broad and includes not only fields directly applicable to aeronautics but related ones.

■ The Chemical Division of the Borden Company will double its West Coast output of formaldehyde by building a new plant in the Seattle, Wash., area. The new plant, to be geared to produce more than 36 million pounds of formaldehyde a year, is scheduled for completion late in 1956. It will be under the direction of Ray T. Hanson, the Chemical Division's West Coast general manager.

■ The Garrett Corporation, Los Angeles, Calif., has announced the establishment of its new Rex Division to conduct a long-range research and development program in aeronautics. The Rex Division is headed by E. M. Ellingson, manager, and R. S. Rae, chief engineer.

Miscellaneous

■ Publication of a new journal, *Nuclear Science and Engineering: The Journal of The American Nuclear Society,* has recently been announced. J. G. Beckerley of the Schlumberger Well Surveying Corporation, Houston, Tex., has accepted editorial responsibility. He will be aided by Francis T. Miles of Brookhaven National Laboratory, associate editor, as well as by a publications committee consisting of Harold Etherington, Winston Manning, and Alvin M. Weinberg.

The following scientists have agreed to serve on the editorial advisory board: *Physics,* Harvey Brooks, G. Goertzel, D. G. Hurst, Henry Hurwitz, Jr., O. C. Simpson, R. Taschek; *Chemistry,* L. Cook, Karl Cohen, Stephen Lawroski, E. E. Motta, I. Perlman, J. A. Swartout; *Engineering,* W. K. Davis, O. E. Dwyer, L. J. Koch, Miles C. Leverett, W. T. Moore, John W. Simpson, W. Kelley Woods, Gale Young; *Metallurgy,* J. P. Howe, A. R. Kaufmann; and *Health Physics,* H. M. Parker.

The new journal will be devoted to the presentation of theoretical and experimental papers related to such subjects as nuclear reactor design, construction, and operation; interaction of nuclear radiations and matter; basic phenomena in performance of nuclear fuels; production, uses, and disposal of radioactive materials; chemical processing of nuclear fuels; basic and applied neutron physics; heat-transfer problems peculiar to nuclear reactors; technology of reactor materials; radiological safety, health physics, and nuclear radiation shielding; nuclear instrument research and development; reactor and fission physics; systems for remote handling of radioactive materials; nuclear reactor stability and control; controlled release of energy from nuclear fusion.

One volume a year is planned, and Vol. 1, No. 1 is scheduled for release in February 1956. Subscriptions for Vol. 1, priced at $10, should be sent to the publishers, Academic Press, Inc., 125 E. 23 St., New York 10.

■ A new 40-minute film on x-ray diffraction has been produced by the Research and Control Instruments Division of the North American Philips Company, Inc., 750 South Fulton Ave., Mount Vernon, N.Y. It may be borrowed, or it may be purchased at cost for school and industrial plant libraries.

Titled *The Ultimate Structure,* this black and white sound movie outlines how elements and compounds are identified and measured through studies of the atomic structure. Wave motion and crystal theories are demonstrated and typical examples are shown and described in order to illustrate research and production control applications in industry.

The film describes three analytic x-ray techniques: diffraction, diffractometry, and spectroscopy. The basic differences in the construction and use of the three instruments involved is emphasized.

Erratum: The news item on the American Nuclear Society and its new journal, *Nuclear Science and Engineering* (Academic Press, Inc., New York) that appeared on page 1015 of the 25 Nov. issue should have ended with the second paragraph. The remainder of the item deals with another new journal, *Nuclear Physics* (North Holland Publishing Company, Amsterdam; distributed in U.S.A. by Interscience Publishers, Inc., New York). *Science* regrets the error.

Reports and Letters

Splanchnic Blood Flow after Hemorrhage

It is commonly taught (*1*) that circulatory adjustments after hemorrhage involve splanchnic and cutaneous vasoconstriction with a consequent diversion of the blood flow to those portions of the body that are involved in the somatic response to crisis. Evidence to the contrary (*2*) has been little noted. So far as the splanchnic area is concerned, small hemorrhages (10 ml/kg) have been found to exert only a minor effect on the blood flow (*3*). The cardiac output, however, likewise showed only small change. It has been stated that larger hemorrhages cause transient reductions in the hepatic blood flow, but no measurements of cardiac output were reported (*4*), so that the extent of circulatory embarrassment with these hemorrhages cannot be assessed.

We have found that hemorrhages of 25 ml/kg in the dog anesthetized with sodium pentobarbital regularly result in a diminution of the cardiac output to 60 percent or less of its control value. The effect of such hemorrhages on the splanchnic blood flow was therefore investigated (*5*).

After induction of anesthesia with sodium pentobarbital (30 mg/kg intravenously) and placement of a hepatic venous catheter, the cardiac output was measured by the dye dilution technique (*6*) employing 10 mg Rose Bengal (*7*). Immediately after the sampling of blood for the output measurement, an infusion of Rose Bengal containing 2.0 mg/ml in saline was begun at 0.5 ml/min. Samples of femoral arterial and hepatic venous blood were taken at 10, 15, and 20 minutes after the beginning of the infusion; the precautions outlined elsewhere were carefully observed in the hepatic venous sampling (*8*). The splanchnic blood flow was calculated from the dye clearance (infusion rate/equilibrium concentration in the blood) divided by the arterial-hepatic venous extraction ratio. Concentration equilibrium was attained in all experiments reported.

The animal was then bled through the jugular vein, using a No. 14 needle until 25 ml/kg of blood had been removed. The hemorrhage ordinarily required 10 to 15 minutes. Preliminary heparinization of the animal (20 mg/intravenously) facilitated the bleeding. All animals showed manifestations of sympathetic activity and some degree of air hunger, but all survived the hemorrhage.

One hour after the completion of the hemorrhage, the cardiac output and splanchnic blood flow were again determined by the methods given here. The results obtained in a series of six animals are presented in Table 1.

The cardiac output of these animals before hemorrhage ranged from 133 to 240 ml/kg per minute, with an average of 190. The splanchnic blood flow ranged from 16 to 51 ml/kg per minute with an average of 32. Both the averages and the variability are consistent with our previous experience and that of others (*7–9*). After hemorrhage the cardiac output ranged from 39 to 115 ml/kg per minute with an average of 77. The splanchnic blood flow after hemorrhage ranged from 14 to 37 ml/kg per minute with an average of 24. The estimated splanchnic blood flow (EHBF) showed an absolute rise in four dogs and a fall in two, but in only one case (dog 2) did it show a fall comparable to that in the cardiac output. The splanchnic fraction of the cardiac output, originally averaging 0.17 rose to 0.34. In dog 4 this value was 0.77, indicating that more than three-fourths of the cardiac output perfused the splanchnic bed.

It would appear from these experiments that failing circulation supports the splanchnic bed at the expense of the remainder of the body rather than the converse. This must not be construed to indicate that the splanchnic *reservoir* has not discharged. It is quite clear that a portion of the body may discharge its contained blood while maintaining its perfusion rate.

It remains to be seen whether these findings represent an unusual response of the anesthetized animal. In the absence of experimental evidence to the contrary in the conscious animal, it may be suggested that the usual teaching that the splanchnic blood flow is disproportionately reduced in circulatory embarrassment must be subjected to critical reevaluation.

Table 1. Cardiac output and splanchnic blood flow in anesthetized dogs before and after hemorrhage.

Dog	Wt. (kg)	Cardiac output (lit/min)	Extraction ratio	Blood clearance (ml/min)	EHBF (ml/min)	EHBF/ cardiac output
			Before hemorrhage			
1	14.8	2.6	0.41	98	234	0.09
2	17.3	3.5	0.16	131	833	0.24
3	20.0	4.8	0.37	375	1028	0.21
4	12.8	1.7	0.26	80	314	0.19
5	14.8	3.0	0.39	133	341	0.12
6	16.9		0.32	159	502	
			After hemorrhage			
1	14.8	1.1	0.40	97	247	0.22
2	17.3	1.3	0.38	105	239	0.18
3	20.0	1.4	0.37	129	391	0.28
4	12.8	0.5	0.18	67	382	0.77
5	14.8	1.7	0.36	129	424	0.25
6	16.9		0.27	152	627	

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16 July 1955

Stimulation of Limbic System of Brain in Waking Animals

Phylogenetic and cytoarchitectural studies, together with recent physiological investigations, suggest that the limbic system represents an early neural development involved in the higher control of the autonomic nervous system and in affectively determined behavior (*1*, *2*). The limbic system has a marked influence over the viscera controlled by the autonomic system; hence the designation "visceral brain" is applied to it (*1*).

This paper (*3*) summarizes our studies on 29 cats and 13 monkeys (*Macacus*), in which multilead electrodes were implanted in both cerebral hemispheres in different parts of the limbic system (amygdala both anteromedial and basolateral nuclei, pyriform cortex, hippocampus, temporal tip, posterior orbital gyrus, and anterior cingulate gyrus). After recovery, these areas were stimulated electrically in unanesthetized waking animals. The parameters of stimulation used were 30-cycle-per-second square waves pulses of 0.2- to 1-millisecond duration and 3- to 8-volt intensity.

Affective behavior of the animals showed marked and varied changes on stimulation of different regions. Stimulation of temporal lobe structures, excluding the tip, made the majority of the animals agitated and fearful, but quieted some of them. Temporal tip stimulation of cats made them very irritable. Stimulation of temporal tip in monkeys and stimulation of posterior orbital cortex just rostral to temporal tip in cats made them very vicious and violent. On the other hand, cats with electrode locations further removed from the temporal tip, as well as monkeys, became very quiet during posterior orbital stimulation. Stimulation of the anterior cingulate caused convulsions followed by a typical rage reaction.

Certain somatic movements involving the ipsilateral facial, eyelid, orbital, and oral muscles, and rarely the limb muscles, and also dorsal retraction of the head were obtained by stimulation of all these regions. Contraversive turning of the head (*4*) was obtained only in 6 cats by stimulation of the amygdala, orbital cortex, and cingulate gyrus. Organized movements of "eating" automatisms (*5*) (sniffing, licking, chewing, biting, and chop-licking) were also obtained by stimulation of all the regions. The food intake was not increased by stimulation.

Stimulation of widespread points in all these structures produced signs of autonomic activity that included lachrymation, salivation, pupillary changes, movements of nictitating membrane, and more rarely urination and defecation. The volume of gastric secretion, as well as its HCl (free and total) and pepsin contents, was both increased and decreased by such stimulation; gastric motility was inhibited by stimulation of the temporal lobe structures, and both increased and inhibited by stimulation of the posterior orbital and anterior cingulate gyri. There was usually a rise in blood sugar level resulting from stimulation of all the limbic structures in the monkey; in the cat, there was a rise resulting from stimulation of all these structures except the anterior cingulate. Fall in blood sugar resulted only from stimulation of anterior cingulate gyrus in the cat. Changes in blood pressure were elicited on stimulation of all the different regions. In the majority of cases, stimulation of temporal lobe structures produced a fall, while stimulation of the temporal tip and posterior orbital and anterior cingulate gyri produced a rise. Changes in the respiration, on the other hand, could only be elicited from few points stimulated, and there was no relationship between these and the blood pressure changes. There was usually an inhibition of respiration (even apnoea in some) from stimulation of the anteromedial amygdala, while stimulation of different points in the orbital cortex, anterior cingulate, and temporal polar regions produced both inhibition as well as acceleration (*6*).

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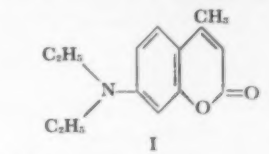
7 July 1955

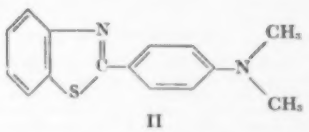
New Liquid Scintillation Phosphors

A number of "whiteners" used in laundry detergents and some other related compounds have been examined for liquid scintillation activity (*1*). Although none of the compounds reported here show properties superior to the best phosphors now available, they represent entirely new classes of compounds in this field and may, therefore, be of interest as a starting point for better compounds and in the study of the liquid scintillation process itself.

About 40 compounds were obtained from five companies: E. I du Pont de Nemours and Company; Ciba Company, Inc.; General Aniline and Film Corporation; American Cyanamid Company (Calco); and the Hilton-Davis Chemical Company. Two of these compounds showed special promise. These were 7-diethylamino-4-methylcoumarin (I) and 2(*p*-dimethylaminophenyl)benzthiazole (II). Compound I was submitted by several companies and can be obtained commercially from a number of sources. Compound II was submitted by the Jackson Laboratory, Organic Chemicals Department, E. I. du Pont de Nemours and Company.



I



II

At the time these measurements were made, the liquid scintillator that gave best results in our laboratory consisted of 0.4-percent 2,5-diphenyloxazole (PPO) and 0.002-percent 1,6-diphenylhexatriene (PPHT) in toluene. The mean pulse height obtained using a cobalt-60 source with this phosphor, flushed with nitrogen, will be referred to as 100 percent. Since these measurements were made, a solution of 0.4-percent PPO and 0.01-percent 1,4-di(5-phenyl-2-oxazolyl)benzene (POPOP) has been used, which gives on this scale a pulse height of 121 percent.

Various preparations of compound I, tested as 0.4-percent solutions in toluene, gave pulse heights from 86 to 100 percent. Compound II gave pulse heights of 90 percent. These compounds were used as received without special effort at further purification. The addition of a secondary solute such as PPHT or POPOP had little or no effect on the scintillation properties of these solutions. In all cases, flushing with nitrogen to remove air increased the pulse height approximately 30 percent.

A number of other compounds showed less promise, but they still showed measurable scintillation activity. These included other amino coumarin derivatives, an amino derivative of benzoxazole, and a derivative of imidazolone.

A considerable number of compounds that were measurably soluble in water were screened for scintillation activity in water. Except for Cerenkov pulses, no activity was observed in any case, al-

though several compounds showed brilliant blue-violet fluorescence under ultraviolet excitation. To my knowledge, all toluene-soluble substances that exhibit fluorescence in the neighborhood of 4000 A and are not colored in this region are more or less good scintillators. Thus, we must conclude that one or more steps of the chain involved in the scintillation process cannot occur in ordinary aqueous solution. Some "shot" experiments have been made with aqueous solutions of these compounds to which additives such as inorganic ions and simple organic substances have been added. None of these gave positive results.

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References and Notes

1. I wish to thank John Marshall of the Institute for Nuclear Studies for suggesting the examination of these compounds. And I also thank the companies that so generously furnished samples for their cooperation in making these measurements possible. This research was supported under a contract with the Office of Ordnance Research.
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20 July 1955

Radiosensitivity of Anoxic Skin in Relation to Temperature

Reduced temperature in mammalian skin during exposure to ionizing radiations is accompanied by reduced radiosensitivity. This is interpreted in terms of an accompanying reduction in vascular supply. The radiosensitivity-modifying effect of alterations in vascular supply is ascribed to accompanying changes in oxygen tension; in effect, the protective influence of reduced temperature is attributed to the anoxic condition that it promotes. This view is supported by the radioresistance-enhancing effect of anaerobiosis in other protoplasmic systems (*1, 2*). However, there appear to have been no studies of the effect of temperature, during irradiation, on the radiosensitivity of skin when variations in oxygen tension are simultaneously precluded. This report is concerned with this question (*3*).

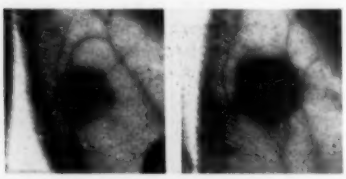

Fig. 1. Typical erythematous reaction 1 week following exposure to 28,800 r in a cooled tissue area (left) and in a warmed tissue area (right).

Homologous areas of the ears of female albino rabbits were simultaneously dehematized and conditioned to different temperatures shortly prior to and during exposure to heavy doses (up to 28,800 r) of soft x-rays (50 kv; 5 ma; 3600 r/min; beryllium window). Intensity of the erythema at 24 hours, 1 week (Fig. 1), and 2 weeks subsequent to exposure and the severity of later lesions, up to 8 weeks subsequent to exposure, were used as criteria of radiation damage. Each area was dehematized for 3 minutes prior to temperature regulation; then followed 10 minutes of combined dehematization and temperature regulation; this, in turn, was followed by 8 minutes of irradiation; the area was then released. Only a single area on any one ear was employed.

The technique is diagramed in Fig. 2. Tissue temperature was regulated by the temperature of the water flowing through the copper chamber. Dehematization was induced by compression; we employed a weight of 1140 g. Tissue temperatures were measured with a thermocouple. The beryllium compression surface insured maximum transmission of x-rays to the tissue. The dehematized area measured 218 mm²; the irradiated area, in the center of the former, measured 95 mm². The fact that circulation was eliminated was demonstrated by injecting Evans blue in the artery of controls; no coloration appeared in the compressed area after this injection. Controls were effected on the opposite ear of one and the same experimental animal; in these, no untoward responses occurred.

This report is based on observations on about 30 warmed and 30 cooled tissue sites. In several instances, the radiation dose and the period of induced ischemia and temperature regulation were less than indicated; these experimental variations did not, however, essentially affect the over-all pattern of response. In general, the radiosensitivity of the anoxic tissue was found to be definitely reduced following irradiation at the lower temperature. The postirradiation responses, at various times after irradiation, of cooled (about 10°C) and warmed (about 39°C) tissue areas that were exposed to 28,800 r follow.

1) At 24 hours after irradiation: in 82 percent of the areas the intensity of the erythema was distinctly less in the cooled areas than it was in the warmed areas.

2) At 1 week after irradiation: in 88 percent of the areas the differential in erythematous response was the same as that described for 24 hours, but the contrast was decidedly greater (Fig. 1).

3) At 2 to 3 weeks after irradiation: with progressing complexity of the lesions, warmed areas continued to exhibit the more severe reaction; this was especially reflected in a corona of inflammation

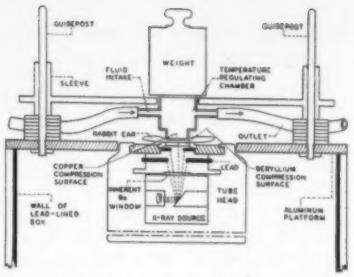

Fig. 2. Device by means of which anoxia, temperature-regulation and irradiation are simultaneously effected in localized areas of the rabbit ear.

peripheral to the irradiated area; this pattern prevailed in 90 percent of the areas.

4) At 4 to 7 weeks after irradiation: the same pattern of response continued and was evident in 96 percent of the areas. At 4 weeks, 40 percent of the warmed areas exhibited sequestration of the irradiated area (perforation); there was no sequestration in cooled areas. At 5 weeks, 83 percent of the warmed areas and 54 percent of the cooled areas exhibited sequestration. After sequestration, the corona of inflammation persisted for a considerable time in warmed areas but disappeared rapidly in cooled areas.

5) At 8 weeks after irradiation: there was total sequestration of the irradiated area in all warmed areas, and the perforation was always significantly larger than that occurring in cooled areas; 60 percent of the cooled areas exhibited perforation significantly smaller than the irradiated area; the remainder exhibited extremely small perforation or none at all.

These observations are offered as evidence, possibly the first of its kind, that the temperature prevailing in anoxic mammalian tissue at the time of irradiation is a significant dose-effect modifying factor.

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3. Work performed under U.S. Atomic Energy Commission contract No. AT(11-1)324 with Marquette University. We were aided (preliminarily) by the Milwaukee Division of the American Cancer Society. The x-ray equipment was provided by the X-Ray Department, General Electric Co. The assistance of Barbara Herbes and Phyllis Galasinski is gratefully acknowledged.

18 July 1955

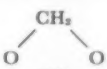
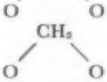
Structural Specificity of Inducers of Protocatechuic Acid Oxidase Synthesis in Neurospora

Although many compounds are known to induce the biosynthesis of specific enzymes in microorganisms (*1, 2*), little information is available on the structural specificity of inducing compounds. This note is concerned with the induction of protocatechuic acid oxidase synthesis by various analogs of protocatechuic acid (3,4-dihydroxybenzoic acid), the only known substrate for this enzyme.

Protocatechuic acid oxidase catalyzes the oxidative rupture of the aromatic ring of protocatechuic acid, yielding a tricarboxylic acid—*cis, cis*-β-carboxymuconic acid (*3, 4*). The enzyme is absent in extracts of wild-type strains of *Neurospora crassa* when they are grown on a mineral medium containing biotin with glucose or sucrose as the carbon source. Synthesis of the enzyme is induced by some of the compounds listed in Table 1 when they are added to the growth medium at a concentration of 100 to 200 μg/ml. The enzyme was assayed in extracts of the mycelia by the spectrophotometric method described elsewhere (*4*).

The metabolism of both *p*-hydroxybenzoic acid and *m*-hydroxybenzoic acid has been demonstrated to proceed via protocatechuic acid in other microorganisms (*5*). *Neurospora* will grow to some extent on *m*-hydroxybenzoic acid and *p*-aminobenzoic acid. It is presumed that the induced synthesis of protocatechuic acid oxidase results at least partly from the endogenous production of the inducer-substrate protocatechuic acid from *m*-hydroxybenzoic, *p*-aminobenzoic, and *p*-hydroxybenzoic acids. Definitive evidence for this will depend on the demonstration of enzymatic conversion of these compounds to protocatechuic acid *in vitro*, which thus far has been unsuccessful.

Table 1. Compounds tested as inducers of protocatechuic acid oxidase synthesis. Response: +, maximal enzyme synthesis; ±, less than one-tenth maximal enzyme synthesis; −, no enzyme synthesized.

Compound	Substitution						Response
	1	2	3	4	5	6	
Salicylic acid	COOH	OH					−
Anthranilic acid	COOH	NH_2					−
2,3-Dihydroxybenzoic acid	COOH	OH	OH				−
2,4-Dihydroxybenzoic acid	COOH	OH		OH			−
Gentisic acid	COOH	OH			OH		−
2,6-Dihydroxybenzoic acid	COOH	OH				OH	−
Pyrogallol carboxylic acid	COOH	OH	OH	OH			−
m-Hydroxybenzoic acid	COOH		OH				+
Protocatechuic acid	COOH		OH	OH			+
Protocatechuic ethyl ester	$COOC_2H_5$		OH	OH			−
Vanillic acid	COOH		OCH_3	OH			+
Vanillin	CHO		OCH_3	OH			±
Isovanillic acid	COOH		OH	OCH_3			±
Isovanillin	CHO		OH	OCH_3			−
Veratric acid	COOH		OCH_3	OCH_3			−
3,4-Dimethoxyphenylacetic acid	C—COOH		OCH_3	OCH_3			−
Piperonylic acid	COOH						−
Piperonal	CHO						−
Gallic acid	COOH		OH	OH	OH		+
3,5-Dihydroxybenzoic acid	COOH		OH		OH		−
Tyrosine	C—CNH_2—COOH			OH			−
p-Hydroxybenzoic acid	COOH			OH			+
Anisic acid	COOH			OCH_3			−
p-Aminobenzoic acid	COOH			NH_2			±
Benzoic acid	COOH						*
Phenylalanine	C—CNH_2—COOH						−
Catechol			OH	OH			−
Shikimic acid (cyclohexene ring)	COOH		OH	OH	OH		−

* Growth inhibited.

The other compounds tested show a rather specific structural dependency with regard to induced enzyme synthesis. An aromatic ring with a carboxyl group or a group easily oxidized to a carboxyl is required. Furthermore, introduction of a hydroxyl group at the 2-position results in complete inactivity. Substituting methoxy groups for both hydroxyl groups of protocatechuic acid completely inactivates the molecule, indicating a requirement for at least one free hydroxyl group in either the meta or para position. Since vanillic acid is about 10 times more effective than isovanillic acid as an inducer, there seems to be a high degree of specificity for the hydroxyl group para to the carboxyl group.

Vanillic acid, the inducer most extensively examined thus far, is not metabolized by the intact organism, is not attacked by protocatechuic acid oxidase, and does not inhibit enzyme activity. 2,4-dihydroxybenzoic acid, although not an inducer, competitively inhibits the oxidation of protocatechuic acid. The specificity of the enzyme-synthesizing mechanism therefore seems different from the specificity of the enzyme synthesized, as has been observed in other inducible systems (*1, 2*).

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15 July 1955

Man Thinking; him Nature solicits with all her placid, all her monitory pictures; him the past instructs; him the future invites. Is not indeed every man a student and do not all things exist for the student's behoof? And, finally, is not the true scholar the only true master? But the old oracle said, "All things have two handles: beware of the wrong one."
—R. W. Emerson, *The American Scholar.*

Book Reviews

Symposium on Atherosclerosis. Publication 338. National Academy of Sciences–National Research Council, Washington, 1954. 249 pp. Illus. $2.

Although this symposium was requested by the Air Force Directorate on Research and Development and was originally designed to emphasize the pragmatic interests of the Air Force, it constitutes in its final form a broad survey of the etiologic factors of atherosclerosis. The contents of the volume are illustrative of the many facets of investigation that have developed since the concept of the essential identity of old age and atherosclerosis has been abandoned.

The first part of the symposium is devoted to examination of the vessel wall and of local factors that determine patchy distribution of atherosclerosis. Consideration is given to changes in composition of elastin, structure of elastic elements in media of arteries, degree of calcium deposit, thickening of intima, and disturbances in medial circulation. There is detailed scrutiny of the consequences of local injury and degeneration in terms of both initial reaction and healing. Attention is drawn to the possible pathogenetic relationship to atherosclerosis of such reparative processes as subendothelial proliferation and the formation in intima of new capillaries that rupture easily with consequent hemorrhage.

There is a short section on the use of newer techniques in the study of blood vessels. This includes discussion of the applicability of electron microscopy, polarization optics, x-ray diffraction analyses, and x-ray absorption spectrography to the examination of large and small vessels.

The role of lipids and lipid metabolism in the pathogenesis of atherosclerosis receives appropriate attention. Although the focus is still centered about the behavior of cholesterol and its esters, the significance of neutral fats and phospholipids is taken into account. There is a fundamental discussion of the entry, transport, and metabolism of fatty acids, phospholipids, and sterols. There is a critical examination of the character and role of lipoproteins in the metabolism of lipids and in the pathogenesis of atherosclerosis. The influence of diets on development and complications of the disease is discussed from the standpoint of excessive caloric intake, relationship of fat intake to total calories, effects of different forms of fat, and variations in cholesterol intake.

As a whole, the symposium furnishes an authoritative text for all who are interested in causative factors of atherosclerosis and its complications.

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The Story of FAO. Gove Hambidge. Van Nostrand, New York–London, 1955. xii + 303 pp. Illus. + plates. $6.50.

Man may not live by bread alone, but food comes pretty close to being first in priority for human beings as well as for God's other creatures. This is especially true for the approximately two-thirds of the world's population that nutritionists declare are undernourished and among whom deficiency diseases are widely prevalent.

Hunger is not new; but FAO and similar programs, both public and private, now under way in scores of underdeveloped nations are expressions of the new conviction that modern science and technology can reduce, or perhaps eliminate, food shortages as causes of human misery.

Today science and scientists are widely accused of making life more complicated and less happy for the individual than in the good old days before science gave man so much knowledge of, and control over, the forces of nature. But no one has raised his voice against the use of science to increase food production where the people are hungry. L. B. Pearson (now Minister of External Affairs of Canada) put it this way in 1945 when he was chairman of the interim commission that set up the Food and Agriculture Organization (FAO): "We know what science could do if harnessed to the chariot of construction. Man's fears have, however, harnessed it also to another chariot—that of atomic obliteration. On that chariot race, with science driven by both contestants, all our hopes and fears and agonies and ecstasies are concentrated."

In *The Story of FAO* Gove Hambidge has again demonstrated his skill in condensing and making understandable to the man on the street the methods and the findings of science and the many ways in which science can be used to advance man's welfare. It was he who was brought into the U.S. Department of Agriculture in 1935 to edit the new type of Yearbook of Agriculture, which won such wide acclaim from scientists as well as laymen.

No other person has anything like the firsthand experience of Hambidge in the events that led up to the creation of FAO and its activities to date. He played a prominent part in the 1943 Hot Springs conference, called by President Roosevelt, that was attended by delegates of 45 nations. It was at this conference that the decision was made to create a United Nations agency to serve agriculture and to improve the nutrition of the world's hungry peoples. Hambidge became the director of information for FAO when it got under way in 1945 and has served the organization in various capacities ever since.

The book, however, is not about Hambidge, for he is innately a modest person. Instead, it is a well-illustrated and interestingly written account of how the three directors-general of FAO in turn have made it the force it has become in nation after nation in fighting rural ignorance, blind tradition in farming practices, inefficient crop and livestock production methods, and the slowness of governments to bring science to the aid of their farmers, their fisheries, their foresters, and those responsible for the nutritional status and economic advancement of the populations they are expected to serve.

The personality of John Boyd Orr, the first director-general of FAO, shines from the printed pages. His great vision and evangelistic zeal gave this new international agency great impetus in the early years and won for it enormous good will from scientists, government officials, and the general public—both in the more industrially advanced nations and in the remote countries where moden science has yet to make much of an impression. Today we know of him as Lord John Boyd Orr, winner of the Nobel peace prize in 1949. But nutrition workers remember him as head of the Rowett Nutrition Research Institute near Aberdeen, Scotland, who, when World War II broke out, gave Great Britain the technical information on which the nation based its highly successful food rationing.

Orr was destined to be disappointed in his hope that an international agency like FAO could be effective in greatly

facilitating the movement of food from surplus-producing nations to the hungry peoples all over the world. Time is demonstrating that the application of science and technology by the underdeveloped nations to increase the production of food and of things they can exchange for food—and not a world food bank administered by an international agency—will be the mechanism by which science and technology can improve human nutrition and raise levels of living.

All royalties on Hambidge's book will go to support the work of FAO.

NOBLE CLARK
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Chemical Engineering Cost Estimation. Robert S. Aries and Robert D. Newton. McGraw-Hill, New York, 1955. xiii + 263 pp. $6.

This is a well-organized effort comprising 10 chapters on cost estimation. It includes an analysis of various cost items entering directly into the manufacture of a product as well as a good deal of pertinent discussion of the economics involved in a chemical enterprise. For the practical engineer, who is daily faced with a need to justify engineering recommendations on a dollars-and-cents basis, the book fills a real need. The authors have drawn extensively from the contributions of Harding Bliss, C. H. Chilton, Roger Williams, Jr., and others.

The chief criticisms to be leveled against the book are (i) failure to use a cost index system or (at least) to recognize its value, (ii) failure to indicate in the cost-of-equipment graphs that the curves are either averages or medians of a considerable spread of data, and (iii) overemphasis on equipment costs at the expense of discussion of items such as transportation, installation, and maintenance costs. The book as it stands is far from being comprehensive. But although it is *dated* and *imperfect* with respect to the matters just indicated there is no denying its immediate usefulness.

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Inorganic Reactions and Structure. Edwin S. Gould. Holt, New York, 1955. viii + 470 pp. Illus. $6.50.

This book was written to serve as a textbook for chemistry students at the senior or first-year graduate-student level. It is to be used with those courses in inorganic chemistry that have developed in recognition of the renaissance of inorganic chemistry and the general lack of knowledge of the subject shown by so many chemistry graduates in the past 20 years. The author states that the book will serve the students who have had courses in both qualitative and quantitative analysis, but it is my opinion that some introduction to physical chemistry is also necessary.

The book is made up of alternating chapters of theoretical and descriptive inorganic chemistry. No attempt is made to cover the chemistry of all the elements, but the common elements of each group are adequately treated, and generalizations are made wherever possible. The theoretical treatment is exhaustive in that all the current rationalizations to "explain" structure and reactions in inorganic chemistry are covered and numerous specific applications are cited. The development of the theories is limited, however, and a good set of lectures will have to accompany the book if the students are to have a real understanding of these theories.

This book will provide an excellent orientation and a review of modern inorganic chemistry for the practicing chemist whose academic training ended before such terms as *bond angles, bond length, bond strength, bond order, sigma, pi,* and *delta bonds, Lewis acids,* and so forth, became standard terms in the chemistry courses. Further works will have to be consulted for complete comprehension of all aspects of this new approach, however. There are few references to the original literature, but there are numerous references to treatises and books on special phases of inorganic chemistry.

I was particularly impressed by the exercises at the end of each chapter. They are thought-provoking, stimulating, and an excellent test of one's ability to apply what has been learned. The information within the chapter is not always adequate to supply the answers to the exercises. For example, the text carries that all-too-common phrase "It may be shown that . . ." but without actually showing that "it" is so. One of the exercises at the end of a chapter states "Show that . . . is so." I believe that this is a good exercise. A number of exercises involve oxidation-reduction potentials at other than the standard conditions. Although the standard oxidation-reduction potentials are given in an appendix, the Nernst equation does not appear in the text. It must be presumed that the student will recall the equation from his course in quantitative analysis.

The only serious omission is a chapter on oxidation-reduction. Even though the topic is referred to repeatedly throughout the book and is covered in piecemeal fashion, it is of sufficient importance to justify a separate chapter.

Typographic and factual errors are few. The implication that pentavalent vanadium is readily reduced to the trivalent state by SO_2 in acid solution is erroneous, since the reduction proceeds only to tetravalent vanadium.

Inorganic Reactions and Structure is a worth-while addition to the growing list of modern inorganic books and will be valuable both as a textbook and as a guidebook to bridge the gap between the "old" and the "new" inorganic chemistry. It should serve as a stimulus to many chemistry departments to offer a course wherein such a textbook will be appropriate, because too few such courses are being offered at the present time.

CHARLES R. NAESER
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A Study of the Brain. A companion text to the stereoscopic atlas of neuroanatomy. Hyman S. Rubinstein. Grune and Stratton, New York, 1953. xiii + 209 pp. Illus. + plates. $9.50.

Designed to be used in conjunction with the author's *Stereoscopic Atlas of Neuroanatomy,* yet complete in itself, this textbook is intended to provide students with a functional approach to the organization of the central nervous system by guiding them through a dissection of the human brain. The first chapter provides directions on how to proceed with the dissection; interspersed at appropriate points in its text are suggestions with regard to the portions of subsequent chapters that should be studied in conjunction with a particular stage in dissection or before proceeding farther with it. The subsequent chapters, which represent the material usually covered in textbooks of neuroanatomy, are in turn generously populated with references to the "Atlas of transverse sections" and an appendix that follow the text; the latter includes the key drawings of the aforementioned *Stereoscopic Atlas.*

As an approach to the study of neuroanatomy, the plan on which the textbook is organized has merit; for there is no better way to obtain a three-dimensional view of the organization of the brain than by dissection. Unfortunately, the manner and form in which the ancillary material is treated—the text and illustrations—lack the merit of the plan. For example, the value of the "Atlas of transverse sections" is considerably lessened by the fact that too many structures are identified in many of the illustrations; as a consequence, the labels are too small and too crowded to be easily read, and the direction lines are difficult to follow. Many times the identifying line ends in a region in which the structure mentioned may reside but its presence or the limits of its distribution in the case of a

fiber tract cannot be recognized, nor are they indicated. This criticism applies with even greater force to the treatment of most of the line drawings that are included in the appendix. Finally, the usefulness of the text and the bibliography is materially limited because neither was brought up to date; for example, references to Fulton's *Physiology of the Nervous System* are to the 1938 edition, and those to Howell's *Textbook of Physiology* are to the 1922 or eighth edition. No reference is made in the chapter on the hypothalamus to the work of Wislocki or to the work of Harris and Green on the hypophyseal circulation; and none is made to the problems of temperature regulation, obesity, and energy exchange, which are focal points of so much recent work on this region. These omissions and others of similar character seriously limit the usefulness of this book.

DONALD H. BARRON
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The Origin of Vertebrates. N. J. Berrill. Oxford Univ. Press, Oxford, 1955. viii + 257 pp. Illus. $4.

From about 1875 through the 1920's, the origin of the vertebrates was one of the active subjects of evolutionary biology. Then discussion died down from lack of fuel. All the available evidence seemed to be in, and all together was insufficient to warrant much more than a verdict of "not proved." Hardly any new evidence is at hand today, and yet there is room for a reconsideration of probabilities with more perspective than was available when discussion was at its height. As Berrill emphasizes, any hypothesis of vertebrate origin is still speculative, but his exercise in speculative logic, tied to a wealth of detailed observation of indirectly pertinent facts, is well worth while.

Perhaps the most generally accepted (or, at least, repeated) hypothesis has been that of Garstang which was published in final form in 1928 and which stemmed from Willey's views of 1894. According to that view, the ancestral hemichordates and the echinoderms had a common origin. Tunicates arose from ancestral hemichordates and then the vertebrates arose by neoteny from the tadpole larvae of tunicates. The first two-thirds of that hypothesis, emphasized by many students almost to the exclusion of the last third, are now flatly rejected by Berrill. He does not believe that the hemichordates (a name he considers incorrect) are especially related either to the echinoderms or to the true nonvertebrate chordates (tunicates and lancelets). He does agree that in some vaguer sense the grouping of echinoderms, "hemichordates," nonvertebrate chordates, and vertebrates is probably natural, but this casual statement is mysterious because any actual evidence for it seems later to be confuted.

Concerning the vertebrates, Berrill agrees in essence, although not in detail, with the last part of Garstang's hypothesis. The tunicates arose as a group of sessile food-strainers. Tadpole larvae later evolved among the tunicates as an adaptation enabling the animals to settle on a suitable substrate. Neoteny in some of those larvae gave rise to animals free-living and -swimming throughout life. Such neotenous ex-larvae then evolved on the one hand into the degenerate lancelets and on the other into the first true vertebrates (Agnatha). A shift from marine to freshwater environments was supposedly a crucial factor.

Such a brief statement of the thesis does scant justice to an argument that is detailed, eloquent, and imaginative. The author's own characterization of his book as "in a sense . . . science fiction" is justified to the extent that this work, although it is technical enough and honestly linked with factual data, is a rare sort of scientific entertainment. Berrill's last sentence is, "Proof may be for ever unobtainable, and it may not matter, for here is such stuff as dreams are made on." *Perhaps* this is the last word on the chordate ancestry of the vertebrates. As for the ancestry of the chordates, all is left in darkness without even the dream of 60 years ago.

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American Museum of Natural History

The Quantitative Analysis of Drugs. D. C. Garratt. Philosophical Library, New York, ed. 2, 1955. xv + 670 pp. $17.50.

This volume is a carefully prepared compendium of selected methods for the chemical analysis of drugs. Details are adequate for conducting an analysis, and appropriate literature citations are included. Throughout it is evident that the selections have been based on the author's wide experience with procedures of this type. Regrettably, this work suffers from a high proportion of older methods, and some important current methods are omitted. There is no mention, for instance, of the fluorometric determination of epinephrine or of the spectrophotometric methods for barbiturate analysis. The necessity for brevity has prevented any elaboration on the chemical reactions involved in these procedures, and the presentation is usually in the nature of empirical directions.

Many of the drugs are strictly identified with the past generation and have little significance under present conditions of medical practice. This is indicated in a ten-page supplement, which in large part is a list of the drugs described in this volume that have been deleted from the 1954 *British Pharmaceutical Codex*. The British drug nomenclature, particularly in the case of newer drugs, may prove confusing to some in this country, since no synonyms, therapeutic applications, or structural formulas are given.

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Vascular Plants of Illinois. G. Neville Jones, George D. Fuller *et al.* Univ. of Illinois Press and Illinois State Museum, Springfield (Museum Scientific Ser. vol. 6), 1955. xii + 593 pp. Illus. $10.

"Those who may be unfamiliar with botany" write the authors of this book, "often take for granted that the floras of the world are more or less completely known and have been fully and accurately accounted for in existing botanical literature . . . the study of plant populations, particularly from floristic, ecological, and phytogeographical standpoints, [still] presents many fascinating opportunities for scientific investigation in almost any part of the world, and by no means least interesting is the flora of the great Mississippi Valley of North America, part of which includes the richly endowed state of Illinois." The authors clearly recognize that "No report on a flora is, of course, ever complete. Even now, the plants of Illinois are imperfectly known."

This handsome volume, except for its double-column format and different style of printing, is at once reminiscent of Deam's *Flora of Indiana*. It is difficult to think of a better model. The use of small state-county dot maps to show distribution, the inclusion of a full-page vegetation map, a brief description of the flora and vegetation, an account of the principal collectors, and a full bibliography are a few of the laudable similarities between the two. Jones and Fuller depart from their model principally in omitting all keys and a glossary, in emphasizing full synonymy and recording all published references to Illinois plants, and in stressing orders while abjuring varieties and forms. I agree with the use of the standard Englerian sequence of families and orders. Since the authors recognize its artificiality, however, it may be questioned whether there is any value in trying to "modify" it into conformity with assumed phylogeny.

Deam's *Flora of Indiana* very clearly stems from its author's 40 years of field work in his state and has a distinctly per-

sonal flavor. By contrast, this book on Illinois flora is quite impersonal and is presumably based on the examination of a larger number of specimens. In terms of kinds of plants in the two states, the figures for Indiana are 141 families, 690 genera, and 2140 species (16 percent introduced); for Illinois, 156 families, 785 genera, and 2450 species (approximately 25 percent introduced). So far as one may judge by a hasty check, the figures are fairly comparable.

The authors remark that "The science of taxonomy consists also of intensive studies of the plants of a definite area for the purpose of clarifying our knowledge of these plants including attempts to shed light on the origin and evolution of species and their inter-relations with each other." Of the 18 nomenclatural combinations proposed, it is interesting to note that 11 are putative hybrids, perhaps suggesting a trend in future taxonomic studies for which this valuable book will form a solid basis.

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New Books

Atomic Physics. An atomic description of physical phenomena. Gaylord P. Harnwell and William E. Stephens. McGraw-Hill, New York, 1955. 401 pp. $8.

Traité de la Connaissance. Louis Rougier. Gauthier-Villars, Paris, 1955. 450 pp. $6.48.

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Environmental Hygiene. vol. II of *Preventive Medicine in World War II.* Ebbe Curtis Hoff., Ed. Historical Unit, Army Medical Service, Washington, 1955 (Order from Supt. of Documents, GPO, Washington 25). 404 pp. $3.50.

Hydrogen Peroxide. Walter C. Schumb, Charles N. Satterfield, and Ralph L. Wentworth. Reinhold, New York; Chapman & Hall, London, 1955. 759 pp. $16.50.

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Small-Angle Scattering of X-Rays. André Guinier and Gerard Fournet. Trans. by Christopher B. Walker. Wiley, New York; Chapman & Hall, London, 1955. 268 pp. $7.50.

Introduction to Modern Physics. F. K. Richtmyer, E. H. Kennard, and T. Lauritsen. McGraw-Hill, New York, ed. 5, 1955. 666 pp. $8.50.

The Atomic Nucleus. Robley D. Evans. McGraw-Hill, New York, 1955. 972 pp. $14.50.

Organic Insecticides. Their chemistry and mode of action. Robert L. Metcalf. Interscience, New York–London, 1955. 392 pp. $8.50.

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The Value of Judgement. W. D. Lamont. Philosophical Library, New York, 1955. 335 pp. $6.

The World of Bees. Gilbert Nixon. Philosophical Library, New York, 1955. 214 pp. $4.75.

Gas Turbines and Jet Propulsion. G. Geoffrey Smith; revised and enlarged by F. C. Sheffield. Iliffe, London, and Philosophical Library, New York, ed. 6, 1955. 412 pp. $15.

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Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Opinions of the Committee on Professional Ethics. With the code of professional ethics annotated and an analysis of the functions of the committee. National Education Assoc., Washington, 1955. 72 pp. $0.25.

Indian Woods for Battery Separators. Indian Forest Bull. No. 184. M. A. Rehman, Jai Kishen, and O. P. Chawla. Manager of Publs., Govt. of India Press, New Delhi, 1955. 18 pp. 2 s.

The Atom in Our Hands. Union Carbide and Carbon Corp., New York 17, 1955. 40 pp.

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Humanistic-Social Stem of Engineering Education. A classified bibliography. Cooper Union Bull., Engineering and Science No. 33. Compiled by the Cooper Union Library. Cooper Union for the Advancement of Science and Art, New York, 1955. 56 pp. $0.50.

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Scientific Meetings

Instrumentation and Automation

What is instrumentation? What is automation? The meanings of these new words in the popular and scientific vocabulary have not yet entirely crystallized—the words still mean different things, at different times, to different people! Broadly, *instrumentation* has come to mean the part of science and technology that deals with the development, manufacture, and utilization of instruments—in both science and industry—for sensing, comparing, measuring, displaying, recording, computing, and controlling.

A simple explanation of *automation* was provided at the Instrument Society of America's conference and exhibit that was held in Los Angeles 12–16 Sept. A. O. Beckman, past president of the society and chairman of the host committee, stated, "We should differentiate between mechanization and automation. Simply stated, mechanization replaced or amplified human brawn. Automation, on the other hand, supplements the human brain. When you 'automate' a manufacturing process, you include what we call feedback or self-correction. A simple example of this is the common room thermostat. The thermostat automatically controls the operation of a gas furnace, for instance, to compensate for changes in room temperature. When the room gets too warm, your thermostat turns off the furnace; when it gets too cool, it turns it on. A simple instrument thus relieves us of the necessity of remembering to read the thermometer, of deciding whether to turn the furnace on or off, and then of doing what is decided. This is automation."

Automation then, is the application of instrumentation to obtain automatic operation of machines and processes in either industry or science.

Automation in industry is already well established in petroleum refineries, chemical manufactures, and mass production of automobiles and electronic components, and so forth; it is widely expected to result in completely automatic factories in the near future.

In science and engineering, automation deals not so much with the control and processing of physical materials and objects as with "information"—the signals or records of events or measurements. It involves gathering, sifting, sorting, collating, computing, correcting, displaying, analyzing, storing, and utilizing the signals that represent the observations, as well as other signals that represent information derived therefrom.

All these aspects of instrumentation and automation were exemplified in the many products and developments that were shown by the 350 manufacturers participating in the ISA Exhibit, for which more than 14,000 people registered. Also these and many more aspects of instrumentation and automation were discussed in the technical papers presented at the 50-odd technical sessions that were held at the Shrine Auditorium and the University of Southern California.

Some trends noted in the last year or two still continue. There is increasing emphasis on automatic data-reduction equipment and methods for transforming measurements in digital representation for ease and accuracy in transmission, storage, and utilization by digital computers. In addition, there are a larger variety of electronic equipments now available in which transistors and magnetic amplifiers have largely replaced the conventional electron tubes.

A few of the many new measuring instruments exhibited were a sonic flowmeter (Fischer and Porter), a pressure-compensated totalizing gas flowmeter (Librascope, Inc.), frequency modulated pressure gages (Byron Jackson), an aircraft position and homing indicator (Control Engineering Corp.), and self-generating accelerometers, good at frequencies to 10,000 cycles per second with a range to 50,000 *g* (Endevco Corp.). A high-speed camera (Beckman and Whitley) that takes 25 pictures at rates up to 1.2 million per second can also be used to record interferometer patterns analogous to transient pressures in the range of 0 to 50,000 pounds per square inch with frequencies up to 50,000 cycles per second.

New analytic instruments included a thermal gas analyzer, and an automatic infrared spectrophotometer (Beckman Instruments, Inc.), a Raman recording spectrometer (Perkin-Elmer Corp.), an electron paramagnetic resonance spectrometer (Varian Associates), a water-vapor analyzer that measures 0 to 100 parts per million in hydrocarbons (Mine Safety Appliance Co.), and an x-ray absorption meter for measuring sulfur in hydrocarbons (Tracerlab Corp.).

All the technical meetings were well attended. Preprints of many of the papers were available at the conference or from the ISA headquarters, 1319 Allegheny Ave., Pittsburgh, Pa. A feature of these conferences that is growing in importance and value is the associated "clinics." These consist of demonstration sessions where selected manufacturers explain in detail the theory and operation of some particular class of instruments to groups small enough so that each person in attendance can participate fully in the discussions. Three such 3-day clinics were arranged on "Analytic instruments," "Computers," and "Instrument maintenance," each serving 200 to 500 persons. In addition there was a 1-day "Workshop on Data Handling" in which 12 groups, each limited to 25 to 50 persons, discussed informally selected phases of the data-handling field. The small workshop type of meeting permits a somewhat larger group to be "in" on the type of conversation that usually goes on between experts in the halls.

It is perhaps unfortunate that there was not a session on instrumentation and the philosophy of science, and possibly this would be a good symposium for some future meeting of the AAAS. One of the most significant trends in the growing field of instrumentation is its explosive growth into the "information-handling" field. This is popularly associated with the great successes of the large high-speed digital computers in solving long and complex mathematical problems and in mechanizing some of the clerical operations of the Census Bureau, insurance companies, and banks. To the extent that any scientific experiment, procedure, or analysis can be reduced to identifiable and repetitive operations, automation may be applied to such parts of science to increase efficiency and output. In these times of shortage of brain power, any development that promises such increased efficiency should be warmly welcomed. Scientists in all fields should make it their business to learn more about the possibilities of applying in their own laboratories these new techniques from the automatic factory, the guided missile, and the mechanized office.

At the Los Angeles meeting, the council of the ISA approved major changes in the society's constitution, providing for seven additional vice presidents to be selected on a regional basis and to serve on the executive board.

W. A. WILDHACK
National Bureau of Standards, Washington, D.C.

Kodak reports to laboratories on:

looking through the microscope with movie film and camera . . . materials for autoradiography . . . keeping tabs on tocopherol

Cinephotomicrography

That motion pictures made through the microscope might have much value both as an investigative technique and as an aid to scientific communication and instruction doubtless occurred to thoughtful men in earliest nickelodeon days, if not before. Certainly the art has been widely and effectively practiced and improved since then, but how many laborers in the various vineyards have had too many other important and more difficult matters meriting their attention to give thought to what cinephotomicrography could do for them?

Therefore, with no loftier motive than moving a little merchandise, it may be that by publishing a new revision of the booklet, "Motion Pictures Through the Microscope," we shall accomplish the greater good of a seed dropped in the right place at the right time.

The booklet speaks of how to use a motion-picture camera to alter the apparent rate of events on a microscope stage, making them many thousandfold faster or four times slower, as desired; of the details of aligning camera with microscope; of illumination, exposure, color rendition, the defeat of vibration, and a hundred other petty points that distinguish exasperation from proud achievement.

A copy of "Motion Pictures Through the Microscope" (Kodak Pamphlet N-2) is obtainable without charge from Eastman Kodak Company, Sales Service Division, Rochester 4, N. Y.

Cinephotomicrograph by E. J. Farris.

Artist's choice

Autoradiography is the art of arranging for a radioactive substance to take its own picture. In calling it art, we choose our word with care, for everyone who practices it has his own problems and his own solutions, which he knows are better than anyone else's solutions.

Some prefer to bind their subjects in contact with photographic plates. For them we supply *Kodak Autoradiographic Plates, Type A* or *Type No-Screen*. The former are chosen for fineness of grain, the latter for high sensitivity. Both have emulsions about 25μ thick that locate β- or γ-emitters.

Some want plates with emulsions up to 200μ thick, in which paths of individual β- or α-particles are long enough to be plotted back to their origins. For them we supply *Kodak Nuclear Track Plates* in five different sensitivities and six different emulsion thicknesses.

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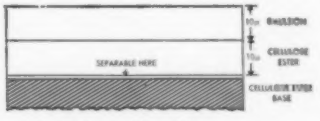
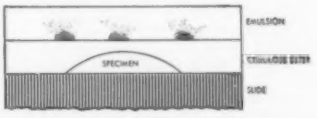


and winds up like this,



the impermeable layer serving to protect the emulsion and the specimen from each other.

Some who strive for best resolution of blackened areas (rather than of individual particle tracks) want a thin emulsion and are more interested in how close to the specimen they can get it than in how well they can separate the two. For them we have *Kodak Autoradiographic Permeable Base Stripping Film*, where the emulsion is only 5μ thick and mechanically supported by 5μ of plain gelatin that provides support between the peeling and the mounting steps, goes on the outside after mounting to protect the emulsion during exposure, and is permeable to the solutions during processing.

Others find this breadth of choice too narrow. Only with liquid emulsion, these brave souls plead, can they get the radiosensitive layer exactly where they want it and as thick or as thin as they want it. But we, who have worked with liquid emulsion for 75 years, know what delicate, perishable, and variable stuff it is and that its handling is no whit less important than its composition and compounding.

Believe us, it is neater all the way around to solve your autoradiographic problems with one of the above-italicized plates or films, obtained from a Kodak dealer. Nevertheless, those who have concluded that only liquid emulsion will do may state their cases by letter to Eastman Kodak Company, Special Products Sales Division, Rochester 4, N. Y., and await developments. Yes, and we even go so far as to offer free reprints of the recent Nucleonics *article, "Alpha-Particle Autoradiography with Liquid Emulsion."*

996 on E

One of the services we talk about in the bold type at the bottom of this page is the compilation of annotated bibliographies of vitamin E, a task we assume by virtue of our position as supplier of that vitamin to the pharmaceutical and feed industries. The new Volume III, covering only '52, '53, and most of '54, abstracts 996 scientific communications. It is utterly dispassionate, advancing no proposition other than that vitamin E occupies the attention of a great many chemical, physiological, and clinical investigators the world around.

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Meeting Notes

■ The fifth Pan American Congress of Ophthalmology will be held in Santiago, Chile, 9–14 Jan. 1956, under the auspices of the Pan American Association of Ophthalmology, of which Moacyr E. Alvaro, São Paulo, Brazil, is president. In accordance with a custom of inviting a distinguished ophthalmologist of the host country to preside, Christobal Espildora Luque of Santiago will be president of the congress.

The scientific program will consist of 11 symposia, in which the speakers will be in general divided between physicians of the United States and Canada and those of Mexico, Central America, and South America.

An important feature of the program will be the Harry S. Gradle lecture, honoring the memory of the first president and one of the founders of the association, the late Dr. Gradle of Chicago. The lecture will be delivered by Frederick C. Cordes, clinical professor and chairman of the division of ophthalmology at the University of California Medical School, San Francisco.

Reports will be received from committees, including those on prevention of blindness; medicolegal ophthalmology; industrial ophthalmology; research; fellowships; interprofessional relationships; establishment of examining boards in Latin America; standardization of ophthalmic hospitals and clinics; graduate education, particularly through home study courses. The Committee on Prevention of Blindness is planning a program to include as topics of discussions: definitions of blindness and amblyopia for medicolegal purposes; bases for classification of causes of blindness; and preparation for the program to combat blindness in Latin American countries.

Several physicians of the United States will take part in the scientific exhibit. From the Armed Forces Institute of Pathology, Walter Reed Medical Center, Washington, D.C., there will be an exhibit on diseases of the optic nerve, shown by Lorenz Zimmerman, chief of the ophthalmic pathology section, and William R. Armstrong, ophthalmology section. From the School of Aviation Medicine, Randolph Field, Tex., will come an exhibit entitled "The mechanism and prevention of penetrating wounds of the eye from high speed splinters," shown by H. W. Rose.

Brittain F. Payne, executive surgeon and director of clinics and pathology, New York Eye and Ear Infirmary, with two associates, Edgar B. Burchell and Marie Cullen, will demonstrate "Graduate instruction in histopathology of the eye." The American Board of Ophthalmology will be represented by explanatory material concerning its membership and operation.

■ The Western Spectroscopy Association, organized in 1953 to fill the need felt by spectroscopists in the 11 western states for regular West Coast scientific meetings concerned with the general field of molecular spectroscopy, will hold its third annual conference at the University of California, Berkeley, 26–27 Jan. 1956. The program will consist entirely of invited papers, with one session devoted to a panel discussion on "Frontiers of research in infrared and microwave spectroscopy." Another half-day will be devoted to astrophysical spectroscopy, one to paramagnetic resonance spectroscopy, and one to the spectra of dye molecules and rare-earth ions.

There will be an instrument exhibit, chiefly of commercial spectroscopic equipment, and various social events will be planned. All interested persons are welcome to attend this meeting. Further information may be obtained from the present chairman of the association, Dr. John W. Otvos, Shell Development Company, Emeryville, Calif.

■ The fifth annual Symposium on Blood is scheduled to be held at Wayne University, College of Medicine, on 21 Jan. 1956. A total of 15 papers related to recent advances in hematology will be presented.

Society Elections

■ Society of Nuclear Medicine: pres., Milo Harris, 252 Paulsen Bldg., Spokane, Wash.; pres.-elect, Norman J. Holter, Helena, Mont.; sec., R. G. Moffat, 2656 Heather St., Vancouver 9, British Columbia; treas., R. Labbe, University of Oregon.

■ Council of American Bioanalysts: pres., Marion F. Dooley, Dallas Tex.; pres.-elect, Thomas S. Hosty, State Department of Public Health, Montgomery, Ala.; treas., Elisabeth Zacher, Oakland Clinical Laboratory, Oakland, Calif. Vice presidents are Victor Dozoretz, Dozoretz Clinical Laboratory, Buffalo, N.Y.; Gustina Zimmerman, Zimmerman Laboratory, Flint, Mich.; and Frank Kolos, Physicians Clinical Laboratory, San Francisco. The executive secretary is Lucian Hertert, Hertert Clinical Laboratory, 490 Post St., San Francisco.

■ Geological Society of America: pres., George S. Hume, Scientific Services, Copeland Bldg., Ottawa, Ontario, Canada; past pres., Walter H. Bucher, Columbia University; v. pres., Richard J. Russell, Louisiana State University; sec. and executive officer, H. R. Aldrich, G.S.A., 419 W. 117 St., New York 27; treas., J. Edward Hoffmeister, University of Rochester. Hume and Aldrich are representatives to the AAAS Council.

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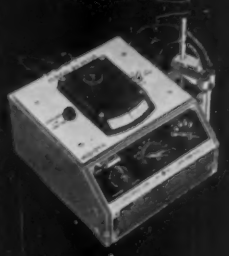

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■ American Heart Association: pres., Irvine H. Page, Cleveland, Ohio; pres.-elect, Edgar V. Allen, Rochester, Minn.; treas., Berkley D. Johnson, New York. The vice presidents are William H. Bunn, Youngstown, Ohio; S. DeWitt Clough, Chicago; Mrs. Preston Davie, New York; Eugene B. Ferris, Emory University; Louis E. Martin, Los Angeles, Calif.; A. W. Robertson, Pittsburgh, Pa.; David R. Rutstein, Harvard University; and Robert W. Wilkins, Boston University.

■ Association of Military Surgeons of the United States: pres., Winfred P. Dana, U.S. Navy; sec.-editor, Robert E. Bitner, Suite 718, 1726 I St. NW, Washington 6, D.C.; exec. sec., Stuart E. Womeldorph, Suite 718, 1726 I St. NW, Washington 6. The vice presidents are Amos R. Koontz, Arden Freer, H. H. Twitchell, Wallace H. Graham, John W. Cronin, and James P. Cooney. Representative to the AAAS Council is Joseph H. McNinch.

■ American Dental Association: pres., Bernerd C. Kingsbury, San Francisco; pres.-elect, Harry Lyons, Medical College of Virginia; 1st v. pres., Francis J. Herz, San Francisco; 2nd v. pres., M. C. Hansen, Racine, Wis.; 3rd v. pres., Marvin E. Kennebeck, Office of the Surgeon General, U.S. Air Force, Washington, D.C.; sec., Harold Hillenbrand, 222 E. Superior St., Chicago; treas., H. B. Washburn, St. Paul, Minn. Representative to the AAAS Council is H. Trendley Dean.

■ International Association of Milk and Food Sanitarians, Inc.: pres., Harold S. Adams, Indiana University Medical Center; pres.-elect, Paul Corash, Milk Division, City Health Department, New York; sr. past pres., John D. Faulkner, U.S. Public Health Service, Washington, D.C.; jr. past pres., I. E. Parkin, Pennsylvania State College; 1st v. pres., William Hoskisson, Arden Sunfreze Crys., Salt Lake City, Utah; 2nd v. pres., Harold B. Robinson, U.S. Public Health Service, Washington, D.C.; sec.-treas., H. H. Wilkowske, University of Florida; exec. sec., H. L. Thomasson.

■ Society of General Physiologists: pres., Ç. Stacy French, Department of Plant Biology, Carnegie Institution of Washington, Stanford, Calif.; v. pres. and pres.-elect, Daniel Mazia, University of California, Berkeley; sec., Abraham M. Shanes, National Institutes of Health, Bethesda 14, Md.; treas., Irvin M. Klotz, Northwestern University.

■ American Documentation Institute: pres., Joseph Hilsenrath, National Bureau of Standards, Washington, D.C.; pres.-elect, James W. Perry, Western Reserve University; past pres., Scott Adams, National Institutes of Health, Bethesda, Md.; sec., Staffan Rosenborg, Library of Congress, Washington 25, D.C., treas., Kenneth H. Fagerhaugh, Carnegie Institute of Technology. Representative to the AAAS Council is Milton O. Lee.

Forthcoming Events

January

9–10. National Symposium on Reliability and Quality Control in Electronics, 2nd, Washington, D.C. (J. W. Greer, Bureau of Ships, Navy Dept. Code 815, Washington 25.)

9–10. Operations Research Soc. of America, 8th national, Ottawa, Ont., Canada. (J. Abrams, Dept. of National Defense, Ottawa.)

9–14. Pan American Cong. of Ophthalmology, 5th, Santiago, Chile. (T. D. Allen, 575 Lincoln St., Winnetka, Ill.)

10. American Ethnological Soc., New York, N. Y. (A. G. James, 695 Park Ave., New York 21.)

10–11. Calcium and Phosphorous Metabolism in Man and Animals with Special Reference to Pregnancy and Lactation, New York, N.Y. (R. R. Marshak, Craigue Hill Rd., Springfield, Vt.)

12. American Genetic Assoc., Washington, D.C. (S. L. Emsweller, Plant Industry Sta., Beltsville, Md.)

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12. British Columbia Acad. of Science, Vancouver, Canada. (W. J. Polglase, Dept. of Biochemistry, Univ. of British Columbia, Vancouver 8.)

12–14. Use of Isotopes in Agriculture, East Lansing, Mich. (E. W. Phelan, Argonne National Lab., Lemont, Ill.)

16–18. Documentation Conf., Cleveland, Ohio. (J. H. Shera, School of Library Science, Western Reserve Univ., Cleveland 6.)

17–20. American Pomological Soc., Rochester, N.Y. (R. B. Tukey, Horticulture Dept., Purdue Univ., Lafayette, Ind.)

20–27. Pan American Cong. of Gastro-Enterology, 5th, Havana, Cuba. (N. M. Stapler, 1267 J. E. Uriburu, Buenos Aires, Argentina.)

23–26. American Soc. of Heating and Air-Conditioning Engineers, Cincinnati, Ohio. (A. V. Hutchinson, ASHAE, 62 Worth St., New York 13.)

23–27. Inst. of Aeronautical Sciences, New York, N.Y. (S. P. Johnston, IAS, 2 E. 64 St., New York 21.)

26–27. Western Spectroscopy Assoc. 3rd annual, Berkeley, Calif. (J. W. Otvos, Shell Development Co., Emeryville, Calif.)

27–28. Conf. on Protein Metabolism, 12th annual, New Brunswick, N.J. (W. H. Cole, Rutgers Univ., New Brunswick.)

27–28. Western Soc. for Clinical Research, 9th annual, Carmel-by-the-Sea, Calif. (A. J. Seaman, Univ. of Oregon Medical School, Portland 1.)

30–1. International Conf. on Fatigue in Aircraft Structures, New York, N.Y. (A. M. Freudenthal, 716 Engineering, Columbia Univ., New York 27.)

30–3. American Inst. of Electrical Engineers, New York, N.Y. (N. S. Hibshman, AIEE, 33 W. 39 St., New York 18.)

31–3. American Soc. of Sugar Beet Technologists, 9th biennial conf., San Francisco, Calif. (Western Beet Sugar Producers, Inc., 461 Market St., San Francisco 5.)

31–4. American Physical Soc., New York, N.Y. (K. K. Darrow, Columbia Univ., New York 27.)

February

1–2. Armour Research Foundation Midwest Welding Conf., Chicago, Ill. (H. Schwartzbart, Armour Research Foundation, Illinois Inst. of Technology, Chicago.)

1–3. Case Studies in Operations Research, Cleveland, Ohio. (Operations Research Group, Dept. of Engineering Administration, Case Inst. of Technology, 10900 Euclid Ave., Cleveland 6.)

2–3. National Symposium on Microwave Techniques, Philadelphia, Pa. (S. M. King, Inst. of Radio Engineers, 1 E. 79 St., New York 21.)

5–8. National Citizens' Planning Conf., Washington, D.C. (Miss H. James, 901 Union Trust Bldg., Washington 5.)

9–10. Soc. of American Military Engineers, annual, Chicago, Ill. (D. A. Sullivan, 72 W. Adams St., Chicago 90.)

16–17. National Conf. on Transistor Circuits, 3rd, Philadelphia, Pa. (J. D. Chapline, Remington Rand, Inc., 2300 W. Allegheny Ave., Philadelphia 29.)

19–23. American Inst. of Mining and Metallurgical Engineers, New York, N.Y. (E. O. Kirkendall, AIME, 29 W. 39 St., New York 18.)

19–23. Soc. of Economic Geologists, New York, N.Y. (O. N. Rove, Union Carbide and Carbon Corp., New York 17.)

20–22. American Educational Research Assoc., annual, Atlantic City, N.J. (F. W. Hubbard, AERA, 1201 16 St., NW, Washington 6.)

23–25. National Soc. of College Teachers of Education, Chicago, Ill. (C. A. Eggertsen, School of Education, Univ. of Michigan, Ann Arbor.)

24–25. American Physical Soc. Houston, Tex. (K. K. Darrow, APS, Columbia Univ., New York 27.)

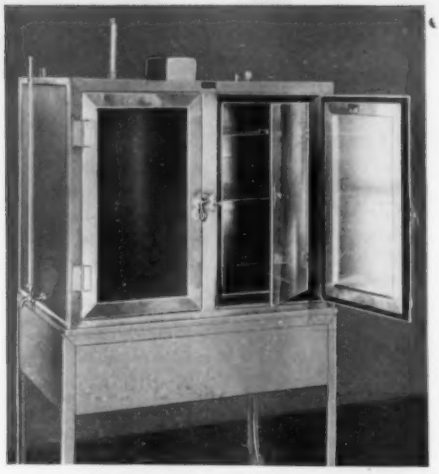
26–29. American Inst. of Chemical Engineers, Los Angeles, Calif. (F. J. Van Antwerpen, AIChE, 25 W. 45 St., New York 36.)

28–29. Scintillation Counter Symposium, 5th, Washington, D.C. (G. A. Morton, RCA Laboratories, Princeton, N.J.)

March

12–16. National Assoc. of Corrosion Engineers, 12th annual, New York, N.Y. (Secretary, NACE, Southern Standard Bldg., Houston 2, Tex.)

(See 18 Nov. issue for comprehensive list)



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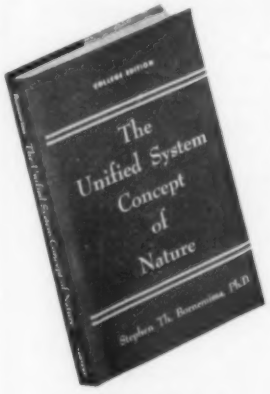

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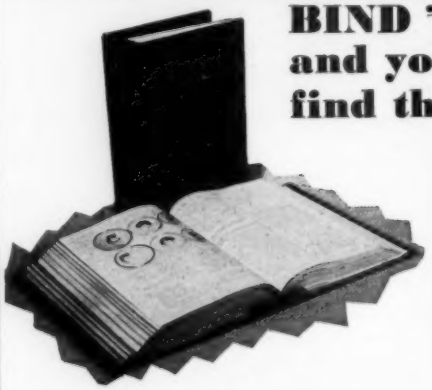

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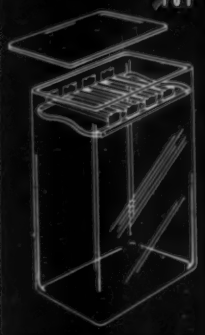

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Program content

1. The four-session symposium, "Atomic Energy and Agriculture," arranged by ORINS.
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3. An AAAS-sponsored "Congress" on the shortage of young scientists and science teachers.
4. Programs of the 17 AAAS sections (symposia and contributed papers).
5. Programs of the more than 60 participating societies.
6. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Editorial Problems, National Geographic Society, Phi Beta Kappa, RESA, Sigma Xi.
7. Details of the Municipal Auditorium—center of the Meeting—and hotels and campuses.
8. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
9. Exhibitors in the 1955 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1955.
2. Complete roll of AAAS presidents and their fields.
3. The more than 265 affiliated organizations.
4. Historical sketch and organization of the Association; the Constitution and Bylaws.
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Atlanta, Ga., December 26-31, 1955

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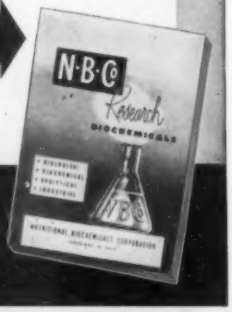

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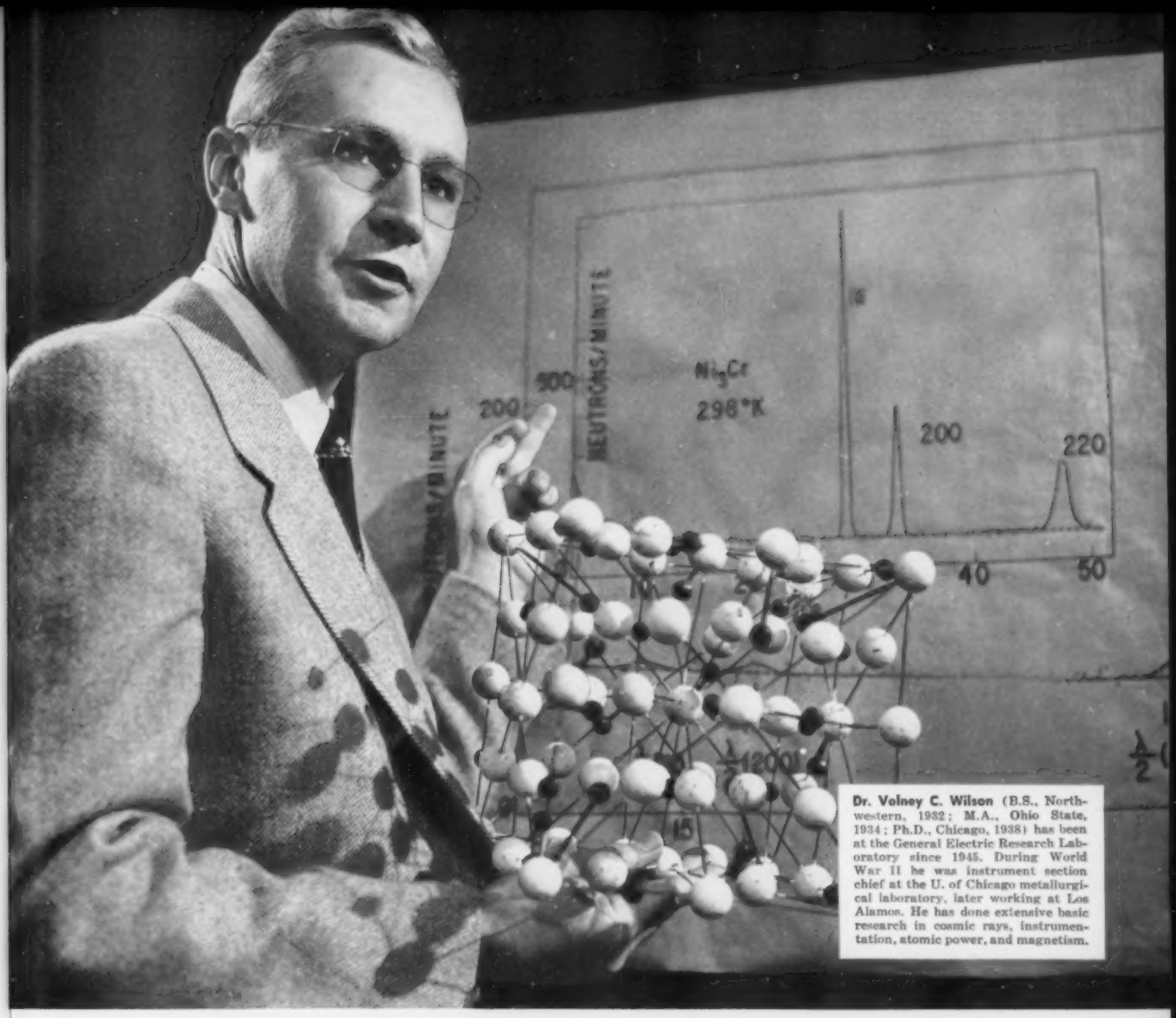

Dr. Volney C. Wilson (B.S., Northwestern, 1932; M.A., Ohio State, 1934; Ph.D., Chicago, 1938) has been at the General Electric Research Laboratory since 1945. During World War II he was instrument section chief at the U. of Chicago metallurgical laboratory, later working at Los Alamos. He has done extensive basic research in cosmic rays, instrumentation, atomic power, and magnetism.

Why magnets are magnets

General Electric's Dr. Volney C. Wilson uses neutrons to discover fundamental facts for improving magnetic materials

While Volney C. Wilson was director of instrumentation and control for the first atomic pile, under the University of Chicago stadium, Enrico Fermi demonstrated to him and others working on the project that neutrons could be diffracted in the same manner as x-rays. Several years later, when Wilson's interests turned to an intensive study of magnetism, he recognized the special value neutrons would have in revealing atomic arrangements in magnetic materials. Neutrons are not affected by *electric fields*, but—since they are very much like little magnets themselves—they are scattered by *magnetic fields* within crystals.

Accordingly, Dr. Wilson designed and constructed a unique *neutron diffraction spectrometer* at the General Electric Research Laboratory. It is now in operation at Brookhaven National Laboratory, giving G-E scientists new insight into the problem of why magnets are magnets. Wilson believes that learning new fundamental facts about "atomic-magnetic" structure will result in better magnetic materials—and that even a small improvement in these materials will significantly increase their usefulness in computers, control equipment, and color television.

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Dept. X9 Please send illustrated catalog on the NEW AO-Baker Interference Microscope and the Theorical treatise on transmission interference microscopy.

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